

RESEARCH ARTICLE



Research on production efficiency evaluation of Trust Company based on DEA– Take 21 trust companies as an example

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Abstract

Trust is one of the important pillars of China's financial system, but since 2017, our country's business entrusted to the total assets fell gradually, the profit growth declining, as trust companies in our country are facing the transformation and strengthening the effective management of product critical moment, so trust company production efficiency research is of great significance to our country. Based on this, this paper selects the data of 21 domestic sample trust companies with a certain size. From the perspective of efficiency, DEA and M-index method are combined to measure and analyze the total factor productivity of Chinese trust companies from 2015 to 2020.

Key words: Trust company, Total factor productivity, DEA, M index

1 | INTRODUCTION

Since 1979, the trust industry has developed in China for 41 years. In the past decade, the trust industry's assets under fiduciary management have grown nearly tenfold. By the end of 2016, the total assets of China's trust companies reached 20.22 trillion yuan, second only to the banking industry. However, with the rapid development, China's trust companies are also facing new problems and challenges. In 2017, the New Asset Regulation and its detailed rules were released, requiring trust companies to remove nesting, fresh, deleveraging and channel. In 2020, CBRC stated that it would stick to the target of "channel removal" and continue to reduce trust channel business and illegal financing trust business. By the end of 2021, the implementation of the new rules on asset management and capital trust will encourage most trust companies to take the initiative to improve management and production efficiency. The important task of the current development of trust companies is to improve their

own competitiveness and cope with the current pressure and challenges, and efficiency can reflect the competitiveness of the trust industry, to enhance competitiveness must attach great importance to efficiency. In this new economic environment, what is the current production efficiency of trust companies? How to maintain existing advantages and solve the problems they are facing, and improve their operating efficiency through business transformation and effective operation, so as to achieve stable and healthy development? Based on this, this paper makes an empirical analysis on the operating efficiency of Trust companies in China by using the DEA-Malmquist method. At the same time, on the basis of empirical analysis of trust companies to improve the production efficiency of the relevant suggestions.

Literature review

Since Charnes et al. (1978) first proposed the use of the data envelopment method (DEA) to compare the relative efficiency of multiple service units providing homogeneous services, DEA has been widely

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used in efficiency studies of various industries. Obi Okey Francis et al. (2020) used the DEA-Malmquist index to measure the logging contract rate and productivity of plantation logging operations in New Zealand from 2009 to 2018, thus obtaining the productivity of New Zealand's forest logging sector. Giselle Cappellesso et al. (2020) used the deA-Malmquist method to measure the innovation intensity of Brazil's food sector, and the results showed that Brazil's food industry is an industry with low TI and R&D investment (R). Xu Na, Zhang Jun, Zhang Renzhi (2020) Based on the data of agricultural water resources, cultivated land area and water-saving irrigation area in inland river basin of Gansu Province from 2001 to 2016, deA-Malmquist method was used to study the utilization efficiency and matching characteristics of agricultural water and soil resources in inland river basin. Chupradit Supat et al. (2021) used CCR and BCC models of data Envelopment analysis (DEA) to estimate the technical efficiency, pure technical efficiency and scale efficiency of Pakistani banks.

At present, with the continuous development of China's trust industry, a large number of scholars gradually began to use frontier analysis method to measure and evaluate the operating efficiency of trust companies. Zhang Qiang and Zhang Bao (2011) analyzed the total factor productivity of 37 Trust companies in China from 2004 to 2008 based on DEA model and M-index. The results show that the average growth rate of total factor productivity varies greatly during the sample period, and the growth of total factor productivity mainly comes from technological change, while the contribution of technological efficiency change is small. Cui Jinghan and Zhou Hong (2015) analyzed the efficiency of trust business by constructing the efficiency measurement model and factor analysis model of trust business. The results showed that the efficiency of trust business had nothing to do with business structure, and the key was whether trust projects and funds were dominated by trust companies. Guo Dong and Deng Xusheng (2016) used the data of 46 domestic trust companies from 2007 to 2015 to analyze the main factors restricting the input-output efficiency of China's trust industry with the restricted panel Tobit model. The results showed that the changes in the domestic market structure and the overall profitabil-

ity of the industry had the most significant impact on the input-output efficiency of trust industry. Macroeconomic environment and policy adjustment have a strong impact on the input-output efficiency of trust industry. Wu Shanshan (2019) used SBMUndesirable model and Malmquist-Luenberger productivity index method to estimate the technical efficiency and total factor productivity of trust companies considering the unexpected output, and made a comparative analysis with the results of the model without considering the unexpected output. It is found that ignoring the impact of NPL may overestimate the technical efficiency and total factor productivity of trust companies. Xu Yihong (2020) constructed an input-output index system through principal component analysis based on the operating data of 64 trust companies in China from 2013 to 2018, and used DEA method to measure the production efficiency of trust companies. The results show that the operating efficiency of trust companies in China is obviously polarized, and the pure technical efficiency of resource allocation capacity is low. Through DEA model calculation, Chen Xueming (2020) found that some trust companies practicing green transformation had problems of low relative efficiency and landslide, which was not conducive to the realization of green transformation of trust.

To sum up, domestic research on the operating efficiency of trust industry is gradually deepening, especially DEA method has been widely used in the evaluation of relative efficiency of the industry, but there is no clear standard for the selection of input and output indicators in industry research. Based on the existing research results, this paper combines DEA model and M-index method to study the total factor productivity of 21 sample trust companies in China, and extends the time to 2020.

2 | RESEARCH METHODS AND INDEX DATA SELECTION

2.1 | Efficiency evaluation indicators

In this paper, DEA method is used to evaluate the total factor productivity of sample trust companies and trust companies are taken as decision making units. Based on the existing studies in the

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above literature and the current business situation of China's trust companies, the input-output indicators are selected as follows:

1. Input indicators

This paper selects paid-in capital, human capital and cost as three input indexes. Among them, paid-in capital is directly represented by paid-in capital in the balance sheet of trust companies. Paid-in capital is linked to the trust's main business and industry rating, which is also an important indicator to measure the future risk defense of trust companies and one of the indispensable input indicators. Human capital is selected from the number of employees disclosed in the annual reports of trust companies. The talent structure of the trust industry is gradually becoming professional, and professional talents play an important role in the innovation and development of trust companies. The cost index is represented by operating expenses in the income statement of trust business.

2. Output indicators

In this paper, the main business income and net profit are selected as output indicators, in which the main business income is subject to the trust income reported in the income statement of trust assets in the annual report of the trust company, while the net profit directly selects the net profit items in the income statement.

3. Data sources

In this paper, 21 trust companies of a certain size in China from 2015 to 2020 are selected as samples. The data of paid-in capital, human capital, expenses, main business income and net profit of input and output indicators are mainly from the annual reports disclosed by trust companies in each year.

(II) Research methods

This paper uses DEA model combined with M index (DEA-Malmquist model) to calculate the total factor production efficiency of Trust companies in China. DEA model is used to calculate the operating efficiency index of each trust company, and M index is used to measure the change value of dynamic efficiency of trust company time series. This method has the following two advantages: First, the time span of the sample data in this paper is from 2016

to 2020, and the time span is relatively short. The non-parametric estimation method can avoid the estimation error caused by the parameter estimation method. Second, Malmquist productivity index method can realize the decomposition of total factor productivity, so as to further find out the factors affecting productivity changes.

1. Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a method to evaluate the relative effectiveness of multiple inputs and outputs of DMU with the same type of service by obtaining the corresponding production front according to the known Data. This method is not only applicable to for-profit organizations, but also to non-profit organizations, and can be widely used to evaluate the input-output efficiency of various types of decision making units. DEA is based on the construction of production technology. On this basis, efficiency is estimated based on the distance between production unit and production frontier. According to different distance functions, efficiency can be divided into radial efficiency and non-radial efficiency. In DEA, the evaluated unit is called a decision unit (DMU). DEA builds data envelope curve by selecting multiple input and output data of decision making unit and using linear programming to take the optimal input and output as production front. Where, the effective point is located on the front surface, and the efficiency value is calibrated as 1. The invalid point is not located in the front plane and is given a relative efficiency value in the interval of (0,1). DEA models are divided into three types, namely CCR model, BCC model and DEA-Malmquist index model. CCR model is mainly used to measure technical efficiency. BCC model mainly measures pure technical efficiency, that is, the ratio of technical efficiency to scale efficiency. Dea-malmquist index model can be used to measure the dynamic changes of DMUs production efficiency in different periods.

2. Malmquist productivity index method

Malmquist productivity index was first proposed by Malmquist(1953). Its advantage lies in that it can analyze panel data and has a wide range of application.

Let X be input, Y be output, and (X_t, Y_t) and (X_{t+1}, Y_{t+1}) represent the input-output vectors of listed

banks in t period and T +1 period respectively. D^t and D^{t+1} represent the relative efficiency of DMU at the technical level of T phase and T +1 phase respectively. Malmquist productivity index model is:

$$tfp = M_{t,t+1} = \frac{D^{t+1}(X_{t+1}, Y_{t+1})}{D^t(X_t, Y_t)} \times \left[\frac{D^t(X_{t+1}, Y_{t+1})}{D^{t+1}(X_{t+1}, Y_{t+1})} \times \frac{D^t(X_t, Y_t)}{D^{t+1}(X_t, Y_t)} \right]^{\frac{1}{2}}$$

When total factor productivity increased from t to t+1, tfp was higher than 1. When in stagnation state, TFP = 1; When it is in a downward trend, TFP < 1. The M-index consists of technical efficiency (EC) and technological progress (TC). Therefore, the formula above can be obtained after transformation:

$$tfp = \left[\frac{D^t(X_{t+1}, Y_{t+1})}{D^t(X_t, Y_t)} \times \frac{D^{t+1}(X_{t+1}, Y_{t+1})}{D^{t+1}(X_t, Y_t)} \right]^{\frac{1}{2}} = EC \times TC$$

The m-index obtained according to the above treatment is $tfp = EC \times TC$. If $EC > 1$, efficiency improvement; If $EC < 1$, efficiency deteriorates. In addition, when $TC > 1$, it indicates technological progress; When $TC < 1$, it indicates that the technology is backward. The technical efficiency change index can be further decomposed into pure technical efficiency change index (PECH) and scale efficiency change index (SECH), that is, $tfp = EC \times PECH \times SECH$.

3 | MEASUREMENT ANALYSIS OF TOTAL FACTOR PRODUCTIVITY OF SAMPLE TRUST COMPANIES

This study uses MAX DEA 8 software based on DEA model to substitute the sorted data of trust companies from 2015 to 2020 into the model, and calculates the total factor productivity change (TFP) of China's trust companies from 2015 to 2020. Technical change (TC), pure technical efficiency change (PECH) and scale efficiency change (SECH) are decomposed.

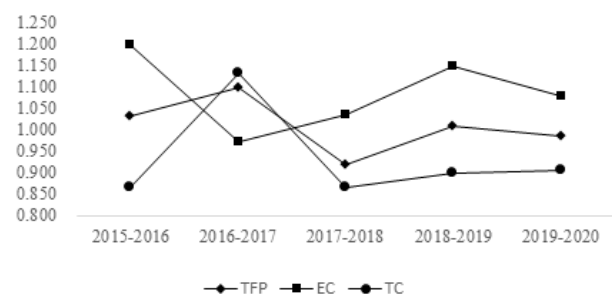
3.1 | Time series analysis of total factor productivity level

Through calculation, the total factor productivity changes of 21 trust companies in China from 2015 to 2020 are obtained, as shown in Table 1:

Table 1 Change and decomposition of the annual average Malmquist index from 2015 to 2020

	tfp	EC	TC	pech	sech
2015-2016	1.034	1.200	0.867	0.962	1.255
2016-2017	1.099	0.972	1.132	1.002	0.979
2017-2018	0.920	1.037	0.867	0.949	1.087
2018-2019	1.010	1.150	0.899	1.115	1.022
2019-2020	0.986	1.081	0.906	1.060	1.020
The mean	1.010	1.088	0.934	1.017	1.073

Figure 1 Change and decomposition of the annual average Malmquist index from 2015 to 2020



As can be seen from Table 1, the average total factor productivity of China's trust industry from 2015 to 2020 is 1.01. A Malmquist index greater than 1 indicates productivity progress. Less than 1, it is the regression of productivity; If the index is 1, there is no change in productivity. The overall level of total factor productivity is greater than 1, indicating that the overall production of the studied trust companies is efficient. During the sample period, the total factor productivity of China's trust companies increased by 1.0%. The growth of total factor productivity mainly came from the change of technical efficiency (8.8%), which restricted the growth of the overall efficiency level (-6.6%).

Combined with figure 1 we can see intuitively and Malmquist index of total factor productivity growth in 2015-2016, drive the M index rising technical efficiency change is trust, and the index of technological change is less than 1, the degeneration of technical

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instructions, also suggests that total factor productivity growth is mainly due to the growth of the technical efficiency change. This shows that the technical efficiency of China's trust companies has improved during this period. By further analyzing the change of pure technical efficiency and scale efficiency, it is found that the rise of technical efficiency is mainly caused by the rise of scale efficiency, but the pure technical efficiency has a slight decline. It indicates that the factor utilization efficiency and management level of trust companies as a whole are low during this period. The Malmquist total factor productivity index (TFP) declined significantly between 2017 and 2018, mainly due to technological regression. Investigate its reason, can contact in 2017, the China banking regulatory commission issued the notice on regulating this kind of business, the notice of this kind of business definition and investigation to clear channel business definition, and for this type of business of commercial bank and trust company code of conduct, under the strict supervision, the size of the trust company growth driven unsustainable model, Coupled with their own management level is insufficient, leading to the decline of most trust companies' economies of scale. Between 2018 and 2020, the total factor production index showed a downward trend, mainly due to the following two reasons: First, increasing regulatory intensity. In 2018, the People's Bank of China and others issued the Guiding Opinions on Standardizing Asset Management Business of Financial Institutions, in which the license bonus of trust industry was cancelled, regulatory arbitrage and rigid means of payment were prohibited. From 2019 to 2020, a series of policies were issued to further tighten supervision on trust business and gradually reduce the scale of illegal financing business until trust companies can rely on their original business to support their business development. Second, since the end of 2019, the epidemic has impacted the domestic and global economic environment, which has hindered the business development of trust companies.

3.2 | Cross-sectional data analysis of total factor productivity level

The 21 trust companies were arranged in descending order according to the total factor productivity value,

and the changes and decomposition of Malmquist index of 21 Chinese trust companies from 2015 to 2020 were obtained as shown in Table 2.

Table 2 Change and decomposition of the annual average Malmquist index during 2015-2020

	TFP	EC	TC	pech	sech
1	0.956	1.062	0.915	1.001	1.081
2	1.14	1.2	0.951	1.102	1.015
3	0.88	1	0.88	1	1
4	0.959	1.06	0.932	0.994	1.067
5	0.905	1	0.905	1	1
6	1.013	1.077	0.944	1.03	1.03
7	1.204	1.219	0.976	1.099	1.194
8	0.936	1.001	0.929	0.998	1.002
9	0.958	1.05	0.923	0.967	1.086
10	1.118	1.254	0.929	1	1.254
11	0.829	0.883	0.929	1.031	0.883
12	1.003	1.001	0.994	1	1
13	1.004	1.12	0.91	1.037	1.085
14	0.939	1.244	0.87	1.07	1.176
15	1.02	1.056	0.962	1	1.056
16	1.317	1.111	1.04	0.949	1.152
17	0.981	1.088	0.898	1.03	1.066
18	1.091	1.215	0.94	1	1.215
19	0.955	1.019	0.948	0.994	1.039
20	0.884	0.968	0.913	0.96	1.004
21	1.113	1.221	0.931	1.102	1.119

As shown in Table 2, there are 10 trust companies with total factor productivity greater than 1, accounting for 47.62% of the total sample, while those with total factor productivity less than 1 account for 52.38%. Among them, there are 13 companies with total factor productivity lower than the mean, accounting for 61.90%. It shows that the overall production efficiency of the trust industry has declined compared with the previous period. The data in the chart reflect the following information: there is a large difference in production efficiency between companies with high efficiency and those with low efficiency in the industry, which is mainly caused by the change in technical efficiency, while there is little difference in the overall technological change of the industry, indicating that the technology of China's

trust industry needs to be innovated and improved. In the sample period, 21 trust company 20 companies in the technology change index is less than 1, investigate its reason has the following two points: one is highly related to domestic high-end training of talents is relatively scarce, domestic also lack training, and human resources play a major role on the management and development of trust companies, thus lead to the efficiency of the trust companies affected. Second, there are some defects in the management and operation mode of trust companies in China, resulting in a certain degree of resource waste.

Through further analysis of changes in scale efficiency and pure technical efficiency, it is found that except for Huaneng Guicheng Trust Co., LTD., the change indices of scale efficiency of the other 20 trust companies are all greater than 1, and most of the pure technical efficiency indices are greater than 1 with little difference. Through analysis, three reasons are found as follows: First, Chinese trust companies constantly improve their management ability in the competition, actively learn advanced experience from foreign trust companies, and strive for efficient and standardized development; Second, China's trust companies rely on the scale growth driven model, constantly expand the company scale, its scale efficiency increases. Third, in recent years, China's trust companies have continuously carried out shareholding reform and acquisition and merger, which has improved the efficiency of resource utilization and pure technical efficiency.

Based on the above analysis, trust companies are faced with key issues such as product transformation, technological progress and management methods to improve operating efficiency, whether due to regulatory requirements, industry competition or industry development.

4 | CONCLUSIONS AND SUGGESTIONS

In this paper, the Malmquist index model based on DEA is used to measure the operating efficiency of 21 sample trust companies in China, and the following conclusions are drawn: From the time series analysis, the total factor productivity of China's trust companies has increased from 2015 to 2020, and the growth of total factor productivity mainly comes

from the change of technical efficiency. However, the technological change index restricts the growth of the overall efficiency level, which means that the sample trust companies still have room for development in technology. According to the cross-sectional data analysis, among the 21 trust companies, the total factor productivity of 13 companies is lower than the average, accounting for 61.90%, reflecting that the overall production efficiency of the trust companies has declined compared with the previous period. Among the 21 trust companies, 20 companies' technological change index is less than 1, 20 trust companies' scale efficiency change index is greater than 1, most of the pure technical efficiency index is greater than 1 and the difference is small.

Based on the empirical results obtained in this paper, combined with the development status and environment of China's trust industry, the following suggestions are put forward to improve the production efficiency of China's trust companies: First, promote the transformation and innovation of business and products, and attach importance to the improvement of operation and management ability. In the current strict regulatory environment, trust companies are required to change the current situation of single business structure, improve the efficiency of management and innovation ability, while taking risk prevention into account, rather than relying only on the growth driven model; Second, standardize business contacts with other financial institutions and consolidate the position of trust companies. After the implementation of the "New Rules on Asset Management", the behaviors of commercial banks and trust companies in banking and trust business will be standardized, requiring trust companies to rely on their original business to support their business development. Therefore, we should strengthen active management, strictly standardize business contacts, and strive to play the advantages of the original business to achieve business transformation. Third, we should learn advanced systems and experience of foreign trust industry, combine with the actual situation of China's financial industry, give full play to existing advantages and improve our competitiveness. Fourth, attach importance to the investment in human capital, absorb high-level educational talents, and attach importance to the relevant training of labor force, and cultivate innovative

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talents in the industry.

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