Evaluation of Enterprise Group Financial Company Efficiency in China by use of quantitative analysis

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Abstract

When you think about it, financial institutions have a *big influence on both financial markets and the actual world. Consequently, more research into the banking sector's efficiency is of critical importance. Essentially, China's financial corporation serves as a "internal bank" for its parent company. As a result, this article relates to the quantitative analysis and assessment approach of the banking industry, which is integrated with data characteristics of the financial company's sector. For the period from 2011 to 2016, the DEA model and the Malmquist index were used to analyse and evaluate the efficiency of 79 Chinese business group financing organisations. Here are the results: According to the DEA model, the overall efficiency of Chinese financial institutions is low, and the effect of scale efficiency is less pronounced than the effect of pure technical efficiency. However, oil processing, steel, and nonferrous metal financial institutions perform better than their counterparts in the rest of the industry. There has been a slight improvement in overall financial company efficiency from 2011 to 2016, based on the Malquist index model, and the efficiency is easily influenced by the change of scale efficiency; from industry category, military financial companies have seen a faster change in overall financial company effectiveness; and the technical progress in auto financial companies has been optimal.*

Keywords: financial institution, efficiency, DEA model, and the Malmquist index model

Introduction

General Bank Finance was established in 1716 as the world's first financial institution, while the US Financial Finance Company was established in 1878 as the world's first non-bank financial institution. For international financial firms, there are two types: enterprises and non-enterprises that are associated with a financial institution. There are a variety of non-bank financial organisations that specialise in consumer lending, corporate finance and financial counselling, but they all fall into one of two categories: those that concentrate on the sale of products and those that don't. Financial businesses have grown in size and breadth as economic globalisation has progressed and financial reforms have been implemented in many nations.. More essential in the global financial market, this new mix of business and finance is becoming increasingly common. Financial businesses are an essential aspect of China's financial sector since they are the non-bank financial entity that is most closely linked to the actual economy. The number of Chinese business group finance firms has grown steadily over the last several decades as the market economy has grown and the appropriate legal structure has been improved. The industry is progressively expanding as a result of the company's constant innovation. Financial enterprises in the Chinese enterprise group total 244 at the end of the third quarter of 2017, whereas service companies total 79,000 or more. Nearly 80 trillion yuan in consolidated assets, and 77.5 trillion yuan in total internal and foreign assets. A whopping 73.548 trillion yuan has been made, and things are looking well for the company. It has an average non-performing asset ratio of 0.03 percent, which is much lower than the industry average. The average capital adequacy ratio in the industry is 22.27, and asset quality has a decent outlook. In recent years, there have been a wide variety of performance metrics for financial institutions. As a result, academics studying financial institution performance assessment are increasingly turning their attention to the efficiency index. Non-bank financial institutions that provide financial management services to enterprise group member units in order to strengthen the centralised management of enterprise group funds and to improve the use efficiency of enterprise group funds are defined in China Banking Regulatory Commission's "Management Methods for Enterprise Group Financial Companies" promulgated on July 27, 2004. As can be observed, the growth of business conglomerates is dependent on the effectiveness of financial institutions. Financial firms' ability to allocate resources, employ resources efficiently, etc., is measured and evaluated in terms of efficiency. It may be seen in the ratio of financial organisations' inputs to outputs in their business operations. Decision-making units that use the DEA technique are more efficient at allocating resources when they input the lowest or maximum number of components under a specific output combination. This represents the efficiency of the decision-making unit's resource allocation. Financial businesses' technological efficiency may be studied by using the DEA approach in this research. These two factors distinguish this paper from previous studies: (1) it uses data from 79 Chinese enterprise group financial companies from 2011 to 2016 as its

sample, which not only increases its sample size but also emphasises its timeliness, ensuring that the research results are more representative; and (2) this paper performs a static analysis of efficiency by year using the DEA VRS model before using the Malmquist index. It makes recommendations based on research on financial firms' efficacy for the firms themselves, enterprise groups, and other major bodies, with the goal of promoting the long-term growth of the financial firms sector. (3) Additionally, here are the other sections: After a literature review, the third section explains how to conduct a research project; the fourth section explains how to collect data; the fifth section explains how to analyse data; and finally, the sixth section sums up the findings and concludes the study.

2. Literature Review

Recently, scientists have been focusing on the effectiveness of financial institutions as a study topic. Related studies are also being conducted, with the focus on financial institutions' efficiency as well as the efficiency of financial firms' operations and other areas. A Study Comparing Financial Institutions from the United States and Other Countries International financial institutions have been around for more than 300 years, yet theoretical studies are still behind. Research conducted by the author to locate relevant literature revealed that the effectiveness of financial institutions was the subject of very few studies in other countries. It is unable to conduct empirical study for the time being since no relevant economic data of financial businesses was obtained via multi-party search. Sustainability 3 of the 17 in the year 2018, 10 3210 Zhang Jianhua (1998) [1] argues that Chinese financial institutions and financial institutions in developed nations have basic qualities, all of which belong to the group's credit institutions, but differ in terms of the sources of funding and the extent of their businesses. It is impossible for China's financial firms to learn from overseas relevant expertise since foreign financial organisations in developed nations are engaged in a broader spectrum of operations and so have more roles. As a result, according to Wang Hongmiao (2002 [2]), the American financial sector has a defined positioning and flexible supervision as well as full support policies. U.S. banks' operational performance is ascribed to the following factors: industrial development financing, supporting system integrity, financial business innovation, diversity of funding sources, and flexible supervision, according to Yuan Jieqiu and Zhu Yu and creamy Zhang Quan (2004). Therefore, the author suggests that the development of China's financial companies needs to improve the market environment to fully play the advantages of professional investment and financing and need for financial innovation, the supervision of financial companies should not be limited to the institutional supervision model, and so forth. 2.2. Financial Institutions' Efficiency Research Fecher and Pierre (1993) [4] used the DEA approach to study the efficiency of financial institutions in 11 countries from 1971 to 1986 and found that Japan had the best level of efficiency among these nations in terms of financial institution efficiency research. The effectiveness of Turkish financial institutions was studied by Isik and Hassan (2002) [5] by using the DEA approach. Valid scale is a major contributor to Turkey's low financial institution technological inefficiency, as shown by the available data. Insurance businesses in 36 countries were studied using the DEA approach by Eling and Luhnen (2010) [6]. As a consequence, insurance businesses throughout the world have seen an increase in their efficiency in the last few years. In addition, Denmark and Japan are the most efficient insurance businesses in the world, while the Philippines is the least efficient. With the use of the DEA approach, Chortareas et al. (2012) [7] analysed EU banking efficiency and concluded that better supervision would help to increase banking efficiency in EU nations. It has become more common for foreign academics to do research on the effectiveness of global financial institutions, particularly in the banking business. With the use of the DEA, Sathye (2001) [8] determined that joint-stock commercial banks in Australia are less efficient than those in other countries because of their lack of technological innovation capability. James et al. (2013) [9] examined the efficiency of 4050 banks in 72 countries between 1999 and 2007 using an unbalanced panel data set and discovered that the degree of bank supervision is inversely associated with the efficiency of banks. The more oversight a bank has, the less efficient it is. Banking sector efficiency and productivity development in India from 2004 to 2011 was examined by Hidemichi et al. (2014) [10] using a new distance function approach that incorporates directional distances. According to the findings, international banks in India have a strong market position and are more efficient than their Indian counterparts.' When it comes to government and commercial banks, the efficiency is poor. Banking's lack of efficiency may be attributed in large part to poor labour management as well as non-performing assets and other sources of revenue. The efficiency of banks in Norway, Turkey, Japan, South Korea, India, China, and other countries was studied from various angles and its influencing factors by other scholars, including Berg et al. (1992), Fare et al. (1994), Berger and Mester (1997), Berger and Humphrey (1997), Das and Shanmugam (2004), Park and Weber (2012), Barros et al. (2012), Chang et al. (2012), Assaf et al. (2013) Researchers Examining Financial

Institutions' Efficient Operation It was argued by Andrewsfen (1961) [20] that most financial businesses improve resource allocation by enhancing operational efficiency Development of the economy is linked to the proper deployment of company resources. In contrast, the financial corporation is part of a larger organisation. In analysing the business risks of the borrower, financial institutions are more equipped than the latter to utilise internal data to lower the likelihood of non-performing loans. Roberts and Viscione (1981a) [21] investigated the reasons for major firm groupings establishing up financial organisations in order to decrease information distortion and loan costs in order to effectively increase the efficiency of the internal market. According to Baryon (2008) [22], it is advantageous for enterprise group members to apply for credit business since the loan prices of financing businesses are cheaper than those of bank loans. In the four years after 2006, Douglas et al. (2014) [23] examined the banking industry in New Zealand. According to empirical study, the financial crisis is linked to asset quality, capital adequacy ratio, and cash flow of financial institutions. Researchers in China, Liu Jinlan and Hu Jingyu (2007) [24], examined the effectiveness of 19 financial institutions in 2002. Analyzing 19 different financial institutions for efficiency, it was shown that the majority of underperforming financial institutions depend too much on the growth of business groupings to carry out their financial responsibilities successfully. By using the DEA research approach, Zhang Wen (2010) [25] studied the efficiency of 32 Chinese financial institutions in 2008. It was discovered that the efficacy of various businesses varies greatly. It is estimated that 90% of businesses are inefficient due to a lack of an independent management idea and model, a low level of capacity to innovate inside the organisation, and a limited number of financial resources available to them. There is an intrinsic link between China's financial liberalisation process and bank efficiency, which was examined using an econometric approach by Jiaxing et al. (2011) [26], who utilised non-parametric data envelopment analysis to generate the Malmquist index. China's banking sector has become more efficient as a result of marketization and open policies, according to a new research. Joint-stock commercial banks are better off than state-owned commercial banks in terms of profitability. From 2009 to 2010, the SFA approach was used to evaluate the cost-effectiveness of 79 Chinese financial institutions. Although financial institutions may help with resource allocation, they are unable to eliminate the duplication that plagues many business organisations. As a result, under the leadership of the group, financial institutions must continue to strengthen their capacity to manage costs and boost the regulatory function of the internal capital market. From 2007 to 2010, Zhu Nan and Tan Debin [28] conducted an investigation on the variables impacting the efficiency of 67 financial businesses using DEA and Malmquist index methodologies. Results demonstrate that most financial institutions' capital use efficiency is unsuccessful, while capital use efficiency fluctuates upwards year after year. A study by Wang Chaoen et al. (2016) [29] examined the link between finance firm efficiency and business group innovation using data from our country's manufacturing group businesses from 2007 to 2013. According to the findings, increasing the efficiency of manufacturing group companies has a beneficial impact on the growth of creative activities inside the company. Only manufacturing group firms are included in this study's statistics, which doesn't account for all finance company efficiency. There is no conclusive evidence on the efficiency of the sector. The growth model and functional placement of financial organisations are also of great interest to Chinese academics. Entrepreneurial organisations, according to Yao Jinren (1996) [30], began by establishing financial firms to increase operational efficiency of finances and maximise the value of capital in their group first. Researchers Ji Min and Liu Hong (2000) [31] looked at how financial institutions work inside Chinese business conglomerates from a different angle. They felt that the rise of industrial financing was directly tied to the size of the industry. Enterprise group financial businesses should aim to become professional industrial finance institutions so that they may deliver high-quality services to the group industry on account of the large size of the industrial finance. According to Li Hui (2013) [32], finance companies may aid in the optimization of the internal structure of business groupings. Group costs may be reduced, and group resources can be allocated more effectively, as a result of this method. Because of this, financial businesses need to have effective and efficient administration of their company groups in the growth stage. Financial services and service quality can only be enhanced to a certain amount and the whole group can be developed more quickly and more effectively if the enterprise group is involved in the process. 2.4. Review of Related Literature To summarise, the prior research has shown positive findings, which serves as a vital foundation for this new investigation. It's not perfect, but it's a good starting point for further investigation in this study. The theoretical study of financial businesses by Chinese academics is still in its infancy. The study's content and methodology are based on previously published studies from other countries, although the effectiveness of financial institutions has not been thoroughly examined. But in recent years, a growing number of domestic experts have started to focus on the study of financial company efficiency. Because financial institutions' data isn't publicly available and there aren't many ways to get it, much of the study on financial institutions is focused on

development models, function positioning, and other non-efficiency-related topics. Many studies on efficiency, however, merely compare and analyse individual years for the relative efficacy of a few financial institutions. Research findings may not be universally applicable because of the limited number of samples. Research on the dynamic changes in efficiency is sparse, particularly empirical research on financial businesses.. Therefore, this study will increase the scope of research on the efficiency of financial organisations by drawing on the current literature. : Using data from 79 Chinese business group finance organisations between 2011 and 2016, the study not only increases its original research sample size but also highlights its timeliness, resulting in more representative research findings. This study, on the other hand, proposes ways to increase the efficiency of financial institutions. The findings of this study will be useful to financial company enterprise groups in their efforts to improve financial company management and to serve as benchmarks for financial company industry ratings. Furthermore, it may assist CBRC and other regulatory authorities in implementing more effective classification regulation for financial organisations, so as to safeguard the long-term viability of the financial sector.

3. Research Methods

Deposit and loan business is the primary business of the majority of financial institutions, as they can only do business inside their groupings. As a result, researchers' research techniques for banking efficiency may be utilised as a reference for financial company industry efficiency research methods. Data envelopment analysis (DEA) and the stochastic frontier technique are often used to assess the efficiency of banks nowadays (SFA). The parameter method includes SFA. For determining the frontier cost function's unknown parameters and determining the least cost to actual cost ratio, this method makes use of multivariate statistical analysis tools. Random error is taken into account as well as the concrete shape of the efficiency boundary function. SFA, on the other hand, has been criticised by Berger and Humphrey (1997), who argue that the pre-determined function form may lead to inaccurate efficiency assessment findings. Sustainable Development 2018, 10, 3210 is the sixth of the 17 in the list DEA is a non-parametric approach established by A. Charnes et al. based on the notion of relative efficiency assessment, which is a systematic evaluation method. In order to compare the relative efficiency of different entities that share the same input and output variables, the DEA technique was developed. The Decision Making Unit is derived from the assessed entity. Data from input and output can be thoroughly analysed, resulting in a quantitative index of comprehensive efficiency for each DMU, which can be used to classify each DMU, determine the most efficient, and identify the extent and cause of ineffectiveness in other DMUs. The DEA method can also provide management information to the appropriate authorities. If the input scale of each DMU isn't adequate, and if each DMU needs to alter its input scale, the DEA approach may help. The DEA approach has some benefits over the SFA method: For starters, although the DEA approach is capable of handling several input and output items at once, it does not need a large sample size and is more flexible when dealing with data. Since the DEA approach has great objectivity, each DMU is not readily impacted by human subjective variables, making it ideal for dealing with both ratio and non-ratio data. In order to examine the efficiency of financial institutions, this article uses the DEA approach. Model 3.1 of VRS Using the DEA as a foundation According to Wei Quanling (2006), there are CRS and VRS models inside the DEA approach. The VRS model is chosen in this study. The VRS model is primarily used to examine efficiency assessment in the event of variable scale income, while the CRS model must meet the assumed condition of invariable scale income. In actuality, financial firms are less likely to earn on a steady scale because of capital limitations and other variables. Because of this, the VRS model is more suited than the CRS model for assessing the efficiency of financial institutions. Financial institutions must adhere to rigorous limits on the quantity of their loans, and they do so by taking into account the size of deposits made by their customers. As a result, the input control capabilities of most financial institutions are greater than their output control capabilities. As a result, the VRS model that is input-oriented is used in this research. There are K DMUs in the model and each DMU may produce Y output using X input. j is the vector of inputs. The DMU is Xj, and the output vector is Yj .'s Relaxation of the output and input of DMU may be summarised as OS (output). (Vector that is always moving. Each DMU's relative technical efficiency may be calculated using the K linear programming solver, and the range of v is 0 to 1. In this case, the DMU is on the edge of effectiveness if v is 1. At the present input level, DMU's output is ideal; if v is less than 1, it indicates that the technology has not yet achieved its optimal level.. In other words, there is a discrepancy between the DMU's actual performance and its ideal performance. The linear programming paradigm used by VRS is shown in the following diagram.:

$$\min\left[\theta_v - \varepsilon\left(\hat{e}_1^T IS + \hat{e}_2^T OS\right)\right]$$

$$\text{S.t.}\quad\begin{cases} \sum\limits_{j=1}^{K} \lambda_j x_j + IS = \theta_v X_0 \\[4pt] \sum\limits_{j=1}^{K} \lambda_j y_j - OS = Y_0 \\[4pt] \sum\limits_{j=1}^{K} \lambda_j = 1 \\[10pt] \lambda_j \geq 0 (j = 1, 2\ldots, K) \\[4pt] IS \geq 0, OS \geq 0 \end{cases}$$

There are two aspects to the technological efficiency. One of the most important aspects of an organization's success is its ability to provide high-quality products and services while maintaining a competitive advantage. Technical efficiency has the same qualities as two other types of efficiency. DMU is effective if efficiency equals 1. The less efficient DMU is, the closer it gets to a value of 1. However, the degree of efficiency is greater. Indicator of Malmquist DMU efficiency can only be compared horizontally using the CRS and VRS models in the DEA approach. The production frontier changes with time due to the increasing influence of time considerations. A longitudinal comparison can't be made across time periods, for this reason. Using temporal and cross-sectional data, the Malmquist index measures total factor production. Time series comparison of panel data using this technique may successfully compensate for the DEA method's flaws in this area. It was initially suggested in the 1950s by Malmquist and others. DEA and the Malmquist index were successfully merged in 1978 after more than 20 years of study and development. When it came time to assess improvements in productivity across multiple sectors, this technique was extensively adopted. Since recently, the Malmquist index has been a popular tool for measuring agricultural and medical sector output. Even in China, empirical research on the cross-year dynamics of industrial efficiency of financial organisations is scarce. From 2007 to 2010, 67 financial organisations in China were studied using DEA and Malmquist index models, however only Zhu Nan and Tan Debin (2015) conducted empirical study on efficiency and efficiency dynamic changes. Therefore, this work uses the Malmquist index model to analyse the static and dynamic efficiency of financial organisations in accordance with the dynamic efficiency of the banking sector. For periods t + 1 and earlier, the Malmquist index is the geometric mean of the total factor productivity index. The following is the model:

$$M_O(x_{t+1}, y_{t+1}, x_t, y_t) = \left[\frac{D_O^t(x_{t+1}, y_{t+1})}{D_O^t(x_t, y_t)} \times \frac{D_O^{t+1}(x_{t+1}, y_{t+1})}{D_O^{t+1}(x_t, y_t)}\right]^{1/2}$$

Dt O (xt, yt) is the input-output distance function in t period with the technology in period of time t as a parameter, and Dt O (xt+1,yt+1) is the output distance function in period t + 1. The input-output distance function in period t is Dt O (xt), while the output distance function in period 1 is Dt O (xt+1,yt+1). There are several ways to modify the Malmquist index.

$$M_{OTP}(x_{t+1}, y_{t+1}, x_t, y_t) = \left[\frac{D_O^t(x_{t+1}, y_{t+1})}{D_O^t(x_t, y_t)} \times \frac{D_O^{t+1}(x_{t+1}, y_{t+1})}{D_O^{t+1}(x_t, y_t)} \right]^{1/2}$$

$$= \left[\frac{D_O^t(x_{t+1}, y_{t+1})}{D_O^t(x_t, y_t)} \times \frac{D_O^{t+1}(x_{t+1}, y_{t+1})}{D_O^{t+1}(x_t, y_t)} \times \frac{D_O^{t+1}(x_{t+1}, y_{t+1})}{D_O^{t+1}(x_{t+1}, y_{t+1})} \times \frac{D_O^t(x_t, y_t)}{D_O^t(x_t, y_t)} \right]^{1/2}$$

$$= \frac{D_O^{t+1}(x_{t+1}, y_{t+1})}{D_O^t(x_t, y_t)} \times \left[\frac{D_O^t(x_{t+1}, y_{t+1})}{D_O^{t+1}(x_{t+1}, y_{t+1})} \times \frac{D_O^t(x_t, y_t)}{D_O^{t+1}(x_t, y_t)} \right]^{1/2}$$

The left portion of formula (3) reflects a change in technical efficiency, whereas the right part represents technological advancement. Technical advancement and efficiency change index may be derived from the Malmquist index (M) according to Fare et al. (1994) study (TECH). There is a pure technical efficiency change index (PTECH) and a scale efficiency change index (SECI) in the latter (SECH). The pure technical efficiency change index, the scale efficiency change index, and the technological advancement change index each indicate the rate of technological renewal in the production sector, whereas the M index changes are influenced by changes in input growth. In other words, M > 1 indicates that DMU's total factor productivity is rising over time, whereas M 1 indicates that DMU's total factor productivity is decreasing with time. TP indicates the M changes brought about by production frontier changes from the t period to the t + 1 period, since the production frontier represents the best efficiency state given the prevailing technological constraints. TECH > 1 indicates a rise in technical efficiency, whereas TECH 1 indicates a loss in technical efficiency. It is said to be positively linked with M if either PTCH or SECH is greater than 1. 3.3. DEA and Malmquist Index Models in Practice. 3.3.1. Literature on Banking Industry Efficiency The DEA Method is used. Chinese commercial banks' efficiency, risk, and technological growth were studied empirically by Tang Qiming and Wen Fu (2011) [34] using the DEA model. In both Chinese and international banks, productivity drops as a result of technological progress. According to Dong Zhu and Zhang Chunge (2011) [35], an empirical comparison of China's major, medium, and small commercial banks was carried out using the DEA model. The effectiveness of small commercial banks on a larger scale is likewise influenced by their own size. Scale efficiency rises in direct proportion to the size of the scale. Zeng Jianhua (2011) [36] examined the efficiency of China's commercial banks and the effect of overseas operations on efficiency. Commercial banks' efficiency improves as a result of foreign operations. It was observed that the efficiency of branches of joint-stock Banks was greater than the state-owned Banks, and that the efficiency of branches could be improved by applying sensitivity analysis and other methods. Malmquist Index Models for Dynamic Change in Banking Efficiency in the Literature From 2000 to 2004, Zhu Chao (2006) [38] employed the Malmquist Productivity index to examine the dynamic efficiency changes of 13 commercial banks in China, and found that the total factor productivity of China's commercial banking sector had decreased marginally. Studying China's commercial banks between 1998 and 2004 with data from the Malmquist Total Factor Productivity Index [39], Wang Fubiu, Jie Chao and Shen Qian (2006) [39] found that productivity in China's commercial banks increased from 1998 to 2004. This increase in productivity was largely due to technological advancements. As a result, the approaches and models discussed in this work are some of the most widely accepted. DEA and Malmquist index models may be used to assess the effectiveness of Chinese financial institutions and the dynamic changes in effectiveness.

4. Data and Variable

4.1. Choosing a Sample There are 79 financial businesses in the sample, and the period from 2011 to 2016 will be used in this study. In terms of industry, these samples are widely distributed in petrochemical engineering; energy; electricity; military; coal; automobile; steel; non-ferrous metals; machinery manufacturing; national defence science; and other industries; and their asset scale accounts for more than 70 percent of the total scale of Chinese enterprise group financial companies. 4.2. Selecting the Input-Output Index Sustainability 2018, 10, 3210 9 of 17 financial

institutions have interest, commissions, and commissions as their primary sources of income. Other sources of income include trust loans, insurance agencies, investment and financing consultants, and other intermediary businesses. Investment income is the final major source of income for the financial services industry (the revenue obtained through purchasing bonds, stocks and other negotiable securities). Interest and investment income make up the majority of a household's net worth. Costs in the financial services industry include interest, commission and commission expenses (expenses given to third parties by entrusting loans, insurance, investment, and financing consultancy) and operating expenses (the costs given to third parties by insurance, investment, and financing consultancy and other intermediate businesses) (business and management fees, business tax, additional and other business expenses). For the most part, the costs are incurred due to interest. This paper believes that financial companies use the intermediary method to convert the absorbed deposits, interbank financing (expressed by interest expenses), and administration expenses into loans and investments, and actively carry out the intermediate business (expressed by charges and commission expenses) in order to generate interest income, fees and commission income, and investment income. Interest expenditures, fees and commission expenses, and management expenses are the input indexes. Interest income, fees and commissions, and investment income are the three output indices. Analysis of Index Correlations While it's recommended to avoid using the same input and output indices more than once, the correlation between the two is strong enough that it can't be prevented. In this research, Spearman's rho technique and SPSS statistical software are used for correlation analysis of input and output measures. Consequently The data demonstrate that interest costs and investment income, interest income, fees and commission revenue have a substantial positive association. Additionally, fees and commission expenditures are linked to interest income, fees and commission revenue, and investment income. In addition, investment income, interest income, fees and commissions are all favourablyconnected with business and management fees. It's time for the index rationality test. The number of decision-making units Q, the input index X, and the output index Y must all meet the formula "2(X + Y) Q" in order to use the DEA technique. 2 (3 + 3) 79 is the empirical sample in the input-output metric system that this study has chosen. The input index is 3 and the output index is 3. The "degree of freedom" criterion of the DEA model indicates that the index selection is logical. 4.5 Descriptive Statistics. Interest costs, commission and commission expenditures, business and management fees, and investment income are used as inputs and outputs, respectively, in this study. First, descriptive statistics are conducted on the six indicators. A comparison of the absorbed deposits, loans, foreign investment and other metrics of Chinese financial institutions from 2011 to 2016 reveals wide variations in the highest and lowest values as well as in the means and standard deviations. Table 1

Table 1. Descriptive Statistics of Input-output Indexes in 2016.

Variable	Minimum Value	Maximum Value	Mean Value	Standard Deviation
Interest expense	327,128.15	970,554,170.68	67,156,471.08	130,332,657.71
Charges expense	-	73,299,680.70	2,276,670.64	9,896,098.11
Business and management fees	1,007,717.75	373,250,695.69	14,041,360.31	43,843,455.77
Interest income	7,488,836.10	1,979,680,644.37	165,436,931.09	291,213,211.47
Commission income	-	150,564,400.75	6,262,639.52	21,671,839.61
Investment income	(7,080,536.98)	261,790,189.13	24,244,232.16	39,547,723.76

Note: (1) The data come from China Monetary Network and Yearbook of Chinese Enterprise Group Financial Companies; (2) the unit of value is the US dollar, the exchange rate is RMB 6.9370 in 30 December 2016.

uses 2016 data as an example to demonstrate the changes in data.

Results and Analysis

A static analysis is performed using DEAP2.1 software and VRS model of DEA, and then dynamic change study is carried out using the Malmquist index model for the 79 chosen sample financial organisations from 2011 to 2016. Static Analysis 5.1 5.1.1. Review of the Situation Overall efficiency in financial organisations is not good, as seen by the average efficiency of enterprise group finance companies, which falls below 1. From 2011 to 2016, the average efficiency of Chinese financial institutions was 0.8737, 0.8862, 0.843, 0.8845, 0.8715 and 0.8922. As a result, even though the financial services sector's size and number of firms have increased dramatically over the years, the efficiency of the industry's financial services providers has not kept pace with these other factors, such as the influence of financial services providers' size, control capacity, and regulatory constraints. The great majority of

financial firms are inefficient in terms of efficiency. From 2011 to 2015, there were less than ten efficient financial companies: Fewer than a quarter of the sample financial companies were efficient in 2011; in 2012, nine were; in 2014, eight were; and in 2015, nine were. In 2016, the sample's efficient financial firms grew from 14 to 15, representing 18.99% of the total. Even Nevertheless, more than 80% of financial institutions were ineffective. Fintech firms may be broken down into pure technological efficiency and scale efficiency according to DEA theory. It is estimated that from 2011 to 2016, there were a total of 27 financial institutions with pure technological efficiency, 32 institutions with scale efficiency, and 15 institutions having both at the same time. There has been a noticeable increase in the number of financial organisations with pure technological efficiency during the last six years. As of 2016, the average efficiency of Chinese financial companies was 0.8715; the average pure technical efficiency was 0.9778; the average scale efficiency was 0.8958; and as of 2011, the average pure technical efficiency was 0.9778; the average pure technical efficiency was 0.9778; and the average pure technical efficiency was 0.9778. In general, the average pure technical efficiency is greater than the average scale efficiency, showing that the efficiency of financial organisations is more impacted by pure technical efficiency than scale efficiency, There is still room for improvement in terms of integrated management and technical innovation, notwithstanding increased investment in recent years. Efficiencies may be improved by focusing on pure technical efficiency while growing the size of the firm and enhancing management level, extending technology input, so as to further boost efficiency. Sustainability 11 of 17 5.1.2. Industry Analysis from 2018 The financial services sector is divided into subsectors based on the industries in which the firms operate. At the end of 2015, the total number of financial companies in the world was 224. There are 17 sub-industries in this industry: energy and electricity production; petrochemical engineering; electronics; coal; construction materials; non-ferrous metals. The automotive industry, trade; tourism; investment holdings. Among the largest industries in terms of assets, petrochemical engineering, the military sector, energy and electricity, construction materials, and electronics came in first place. Total profit in the industry was placed in the top five for energy & power, petroleum engineering, military, car, and coal. As a result, this article will categorise the 79 sample financial businesses into eight industrial categories: petrochemical engineering; military industry; energy & power; coal; non-ferrous metals; car & electronics; and non-ferrous metals & steel. Table 2 shows that in 2015, the petrochemical business had the highest average industrial efficiency among Chinese financial firms, at 0.9208. There were increases in 2015 in the average efficiency of steel and non-ferrous metals manufacturing (0.9113), coal mining (0.883), energy generation (0.863), electronic appliance manufacturing (0.463), military manufacturing (0.465), and automobile manufacturing (0.8491). In 2016, military manufacturing (0.8491) increased its efficiency by 13.7% compared to the previous year, placing it first in the financial services sector. This means that petrochemical and non-ferrous metal industries had an average industrial efficiency of 0.9472 in 2016, followed by steel and non-ferrous metals (0.9014), coal (0.897), vehicle (0.8803) and other industries (0.8578). Rather of focusing on improving their technological efficiency, financial firms in the military sector are increasingly turning to extending their corporate size in order to increase their efficiency in 2016, according to the statistics.

Table 2. Statistical Table of Average Efficiency of Financial Companies in Different Industries.

Industry	Sample Size	Average Value in 2015			Average Value in 2016		
		TE	PTE	SE	TE	PTE	SE
Petrochemical industry	5	0.9208	0.978	0.9406	0.9472	0.9926	0.954
Industry	6	0.8593	0.954	0.9007	0.977	0.9983	0.9785
Energy and power industry	15	0.8808	0.9725	0.9064	0.9014	0.9676	0.9325
Coal industry	5	0.883	0.9964	0.8864	0.897	0.9962	0.9004
Steel and non-ferrous metals industry	9	0.9113	0.9972	0.9136	0.9282	0.9927	0.9349
Automobile industry	6	0.8565	0.9708	0.8833	0.8803	0.968	0.9102
Electronic appliance industry	7	0.863	0.9879	0.8731	0.8487	0.9837	0.8617
Other industries	26	0.8491	0.9893	0.8578	0.8578	0.9926	0.964

The petrochemical engineering, steel, and non-ferrous metals sectors all outperform their counterparts in terms of productivity and efficiency. Only these two sectors have an average efficiency over 0.9 and have shown an upward trend over the last two years. The petrochemical sector increased 2.87 percent, while the steel and nonferrous metals industry expanded 1.85 percent. Why? The financial firms in the petrochemical sector may have superior industry

assets, profit growth, and cost management than the industry average. In spite of the fact that the iron and steel as well as the nonferrous metal industries are experiencing a slowdown as a result of the downturn in the sector, overall profits have grown rapidly. During 2015 and 2016, the average efficiency of the automotive sector was poor. The car sector had a considerable fall in profitability as a consequence of the country's poor economic state. Thus, a variety of profit rate indicators fell to varying degrees, while the cost of doing business rose, indicating a lack of efficiency.

Analysis of Dynamic Change 5.2.1. Conclusions First, we examine the dynamic changes in the efficiency of financial institutions. From 2011 to 2016, Table 3 shows the yearly average change and breakdown of the Malmquist index.

Conclusions and Enlightenment.

Number	Conclusions	Proposal
1	Based on the descriptive statistics of input and output indicators, this paper finds that there are great differences among the financial companies of enterprise groups in China, and there are obvious differences among the financial companies of different industries.	It is suggested that the supervisory department consider some factors such as the differences of the operation scale, the industrial structure and capital operation of the financial companies of enterprise groups to realize the differential management of the financial companies in different industries.
2	This paper uses DEA's VRS model to analyze the efficiency of sample companies in 2011–2016 from a static point of view. The empirical results show that the overall efficiency of China's financial companies is low; efficiency of financial companies is less affected by scale efficiency than by pure technical efficiency.	It is suggested that financial companies speed up technological progress, optimize their own technology and services, and effectively improve the pure technical efficiency. At present, the financial company has become an important node in the enterprise group information chain, with a wealth of large data, and has become the main channel of group fund receipt and payment and fund management and control. Therefore, it is suggested that financial companies should make a deeper and wider radiation to the function of settlement services, so as to give full play to the energy of their payment licences, reduce the waste of resources, and effectively improve operational efficiency.
3	In this paper, the Malmquist index model was used to analyze and study the change of efficiency of sample companies in 2011–2016 from a dynamic perspective. Compared with the change of pure technical efficiency, the change of financial company's efficiency is more easily affected by the change of financial company's scale efficiency. From 2011 to 2016, the change of Malmquist index experienced the process of first rising and then falling. In 2013, it rose to the highest level and then decreased year by year, showing a convex trend.	It is recommended that the enterprise group strongly support the fund collection management of the financial company. On the one hand, it clearly stipulates from the administrative means that the obligations of the member units are to collect the funds into the finance company, and on the other hand, to increase the assessment of the fund collection management. Expand the scale of fund management of the whole group and use scale benefits to further improve operational efficiency.
4	This paper analyzes the static efficiency and decomposition of financial companies from the perspective of industry classification. The empirical results show that the financial companies in the petrochemical, steel and non-ferrous metals industries are more efficient, while the finance companies in the automotive industry are less efficient.	It is recommended that the auto industry finance company should carry out advanced management methods and operation mechanisms for the financial companies in the petrochemical, steel and non-ferrous metals industries, and proceed from the characteristics of their own industries and customer needs, and strive to develop external cooperation, deepen and research customer needs, and integrate utilization. With information technology platform, while optimizing and transforming the original financial service means, channels and products, we will continue to explore new markets and continuously improve execution and management.

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