

# *Efficiency of Chinese Banking Compared with Developed Countries: A Data Envelopment Analysis Approach*

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**Abstract:** This paper applies Data Envelopment Analysis to evaluate the relative operation efficiency and intermediation efficiency of 12 Chinese commercial banks and four foreign banks from 20×9 to 20×1. The aim is to find the Chinese banking efficiency trend after banking revolution and financial crisis. Results show that in China the operation performance is better than intermediation performance and the four state-owned banks have improved significantly in recent years. Moreover, state-owned banks have higher operation efficiency than joint-stock commercial banks, but state-owned banks have no advantages in intermediation approach. Larger and smaller sized banks perform better than do medium banks in terms of operation, while there are no differences in intermediation. Finally, old banks have a better performance both in operation approach and intermediation approach.

## 1. Introduction

Banks, as an important part of financial sector, play a crucial role in the development of the economy. Furthermore, due to the worldwide globalization trend of trading, the competition in banking between countries becomes more and more serious. As a result, every country aims to increase the efficiency of banking in order to improve banking competitiveness. We shall try to analyse the factors affecting efficiency of banks. But first we need to make clear what efficiency is. Based on Yue<sup>[1]</sup>, efficiency is a ratio used to evaluate the amount of outputs with the amount of inputs consumed in a process. In other words, if the amount of input is fixed, the process is more efficiency when the amount of output is larger. This definition of efficiency is also applicable for banks. As a financial intermediation between depositors and borrowers, banks use their resources including labour and equipments to collect money from depositors and offer loans to borrowers. So, there are at least two kinds of efficiency for banks. One is the operation efficiency which regards resources as inputs and the scale of services as outputs. The other is the intermediation efficiency, which uses deposits as inputs and loans as outputs. To improve the competitiveness, banks should take strategies to improve their efficiency in these two directions.

From the crisis, it is clear that banking can improve the economy rapidly, but can also hurt economy rapidly. So, reducing the non-performing loans and keeping bank efficiency at a high and stable level, and thus to reduce the damage of financial crisis, are two of the most critical problems faced by banks<sup>[2]</sup>. For China, it is clear that after the banking revolution and the challenge of

financial crisis, the efficiency of Chinese banking, especially the four state-owned banks, has improved dramatically in this few years. But there are only few articles analysing the Chinese banking efficiency after financial crisis. Thus, this paper will aim to evaluate the banking efficiency after financial crisis to see the efficiency change in different Chinese banks, by Data Envelopment Analysis (DEA). In addition, this paper will also compare efficiency of banks in China and financial developed countries, in order to have a more objective analysis about Chinese banking.

The structure of this paper is as follow. The next section is an introduction of the basic DEA method. The CCR (Charnes, Cooper, and Rhodes, 1978) with constant returns to scale and BCC (Banker, Charnes and Cooper, 1984) with various returns to scale, operation and intermediation approach will be discussed in this section. The third part is the data indexes of 12 Chinese banks and 4 foreign banks selected in this analysis, including inputs and outputs indexes used in both approach. The fourth section, which is the most important section in this paper, is the empirical results of Chinese banking efficiency. The final part is the conclusion of this paper.

## 2. Basic DEA Model

The Data Envelopment Analysis, due to Charnes, Cooper and Rhodes, is a non-parametric method, which is used to evaluate the relative efficiency of different decision making units (DMU), which can be hospitals, commercial banks and so on. According to Charnes, Cooper, and Rhodes<sup>[3]</sup>, a necessary requirement is that the DMUs should have same multiple inputs and multiple outputs, so that, DEA can estimate the performance of each DMU related to other DUMs by efficiency envelopment. A DEA model divides the DMUs into relatively efficient and inefficient combinations of inputs and outputs. A DMU can be regarded as a relative efficiency unit, if it can produce the same level of output with less input or have higher output with same amount of input compare to other DMUs. The inefficient unit, as a result, could always improve its efficiency by reducing inputs or maximizing outputs with fixed inputs. Then all the efficient units with a score of 1 conduct the efficiency envelopment. Thus, in DEA model, decision making units on the frontier are efficient, while the others under the efficiency envelopment are inefficient.

The most famous models with DEA method are the CCR model with the assumption of constant returns to scale and the BCC model with the assumption of various returns to scale. Both CCR and BCC models give an objective efficiency analysis by ratios calculated with outputs and inputs. In addition, there are two orientations<sup>[4]</sup>. The first one is input-oriented CCR model, which focuses on the problem of minimizing the inputs with fixed output. In contrast, the other output-oriented CCR model focuses on the problem of maximizing outputs with fixed inputs. This study focuses on the CCR model to evaluate and compare the relative efficiency among the sample banks and give the direction of improvement.

In the aspect of bank efficiency, there are two main approaches: Operation Approach and Intermediation Approach. Because two methods estimate efficiency from different perspectives, the inputs and the outputs are different. In terms of operation approach, the bank is viewed as a producer which provides services to customers. For instance, banks can open financial accounts and gives advices to customers. So the inputs are the labour, fixed equipments and other operation costs used to support the banking services. This approach evaluates bank efficiency from the cost efficiency direction. In the intermediation approach, as can be known from the name, banks are regarded as an intermediation between lenders and borrowers. So the amount of deposits and loans are the main indexes used to analyse the bank efficiency from the perspective of economic viability<sup>[5]</sup>. This paper will combine operation approach and intermediation approach to evaluate the Chinese bank efficiency with input-oriented CCR model.

Compared with other parametric models, like Stochastic Frontier Analysis model, DEA has

several advantages. First of all, it is more suitable for multiple inputs and multiple outputs. Second, apart from the cost efficiency, the economic efficiency can also be evaluated with the DEA model. So it can give researcher a more comprehensive assessment. Last but not the least, the requirement for data used in the model, for instance, the number of sample data, is much lower than others. Therefore, DEA method is widely used to estimate efficiency in different area, and this is the reason for this paper to choose this method among others.

### 3. Method and Data Analysis

In this study, DEA model will be used to analyse the efficiency of Chinese banks, compared to those in Western countries, in the period from 20×9 to 20×1 with two different approaches, which are operation approach and intermediation approach. Furthermore, there is a big gap between the size of Chinese commercial banks and the size of the four state-owned banks. So the CCR model will be applied to find the minimum inputs with fixed outputs.

To measure the banks efficiency exactly, it is important to choose the appropriate inputs and outputs. As operation approach and intermediation approach analysing the relative efficiency of the banks under two different perspectives, the inputs and outputs of these two methods are different. According to the previous articles and the availability of data, the following inputs and outputs will be included in the data analysis.

For the operation approach, DEA model evaluates the bank efficiency with the cost/revenue management theory. In general, the inputs are the costs which used to support bank operation, while the outputs are the revenues that banks gain from the operation<sup>[6]</sup>. In this paper, there are three inputs and two outputs selected from the income statements of each bank. Inputs: Firstly, due to the characteristic of banks, the interest expenses are the main cost of banks. Therefore, the first input index (X1) is interest expenses. Secondly, to operate the bank service, labour costs including wages and revenues is a necessary part of daily cost, so the index of personnel expenses is selected as the second input (X2). The last input index (X3) is the other operation expenses, which include the capital-related expenses. Outputs: the interest income and the non-interest income, two main revenues that bank received from the daily operations, are chosen as the two output indexes (Y1, Y2).

For the intermediation approach, banks are regarded as financial institutions that collect money from depositors and loan money to borrowers. Based on this, two inputs and two outputs are selected from the balance sheets of the sample banks<sup>[7]</sup>. Inputs: The index of the total deposits received by banks is the first input (X1). The second index (X2) is the total expenses, which are the combination of the interest and non-interest expenses. Outputs: Since banks transfer deposits to loans and securities, therefore, the total loans and the securities are chosen as the output indexes (Y1, Y2).

The data indexes in this paper are all from the annual reports of banks, which is available in BankScope. To analyse the bank structure and bank efficiency in Chinese, 12 Chinese banks with different structure are selected as the sample banks. Also, four commercial banks from the western countries, which are USA and UK, are used to compare with the Chinese banks, in order to find the advantages and disadvantages of the Chinese bank structure. The 16 sample banks are as follow: four Chinese state-owned banks, eight national and regional commercial banks in China, two US banks and two UK banks.

### 4. Empirical Results

In this paper, DEAP 2.1 will be used to do the data analysis and the results of operation approach and intermediation approach will be given separately. The model used here is input oriented CCR

model, which assume constant returns to scale.

#### 4.1 Operation approach

This part will describe the relative efficiency of costs/revenues management in each bank.

After analysing the relative technical efficiency of individual banks with operation approach in recent three years, it can be seen that there are four Chinese banks and two foreign banks were efficient throughout the same period. Some other banks also reached efficiency frontier in one or two years, but less stable. Chinese banking performed very well with an average score of 0.94 during this period. And in the aspect of operation performance, state-owned banks had a higher score than joint-stock banks. Since in China, the scales and reputations of big four state-owned banks rank the top four, they have more customers and more advantages compare to other joint-stock commercial banks. The costs/revenues management of state-owned banks, as a result, is better than joint-stock banks. But compared to foreign banks, Chinese banks still need to improve their operation efficiency by cutting inputs (operation costs including interest expenses, labour-related expenses and capital related expenses) or increasing outputs (interest and non-interest income). With average efficiency of 0.9746, four foreign banks only need to reduce costs for less than 3% in order to reach efficiency frontier. In addition, there is a positive trend that the global banking efficiency, in terms of costs/revenues management, is improving recently.

In summary, during the period 20×9-20×1, the operating efficiency of banking improved gradually and reached a high level, either in China or other countries. Also, the banking system of financial developed countries, such as US and UK, is more mature than banking system in China. At the same time, operation performance of state-owned banks is better than joint-stock banks in China.

#### 4.2 Intermediation approach

This part will describe the relative efficiency of bank as a financial intermediation institution between depositors and borrowers. With the same level of total deposits and securities, if a bank can achieve relative minimum loan and expenses, then it will lie on the frontier and can be considered as an efficient unit.

After analysing the relative efficiency of individual banks with intermediation approach in recent three years, it can be seen that there are only one Chinese bank and two foreign banks kept the efficiency in every year. The three year average efficiency scores of Chinese banking and foreign banking are all less than 0.9, which is fairly high. With a score nearly 0.89, Chinese commercial banks performed better than foreign banks, which only got 0.82. In other words, Chinese banks could transfer deposits and expenses into loans and securities more efficiently. At the same time, US banks performed the worst in these three countries. This is because US banking was damaged the most in the financial crisis. So after that, banks have fewer loans compare the total amount of deposits due to the stricter policy. Moreover, when we look at Chinese banking only, it can be known that, different from the operation performance, the efficiency scores of state-owned banks and joint-stock banks in intermediation approach were nearly the same during the sample period. Therefore, compare to joint-stock banks, the big four state-owned banks have no advantage in this aspect.

### 5. Conclusion

Using Data Envelopment Analysis method, this study analysed the relative operation efficiency and intermediation efficiency of 16 commercial banks including 12 Chinese banks, two US banks

and two UK banks. After analysing, we found that the average efficiency of Chinese banking, whether the operation efficiency or the intermediation efficiency, keeps improving in the three year time. More importantly, for operation approach, the efficiency of state-owned banks is higher than joint-stock commercial banks in China. However, when compared to foreign banking, the efficiency of Chinese banking is much lower. Even the high operation efficiency of state-owned banks is lower than foreign banks. In terms of size, large state-owned banks and smaller sized banks have higher average efficiency than medium sized banks. Also the regional joint-stock commercial banks are more efficient than national joint-stock commercial banks. In terms of age, old banks established before 1990 perform better than new banks established after 1990. Overall, although the operation efficiency in China is at a high level, it still needs to be improved in the future. In contrary, the efficiency of banking in intermediation approach is worse than operation approach. Moreover, the average scores of intermediation efficiency are all below 0.9, which means banks have to reduce more than 10% of their inputs with fixed outputs in order to reach the efficiency frontier. The state-owned banks' intermediation efficiency was lower than other commercial banks' relative efficiency in 20×9, but the former exceeded the later after that and became the most efficiency financial institution in China. Different with operation approach, foreign banks perform not as well as a financial intermediation to transfer deposits into loans and securities. In terms of size, there is no difference when comparing different size of banks. So size has no influence on intermediation efficiency in Chinese banking. In terms of size, with higher efficiency score of old banks, the conclusion is the same as the operation approach. Overall, the intermediation efficiency of Chinese banking is not good enough. Thus, to improve the total Chinese banking efficiency, the intermediation direction is more important than operation direction.

In summary, after the banking revolution in China during recent decades, the efficiency, especially the efficiency of four state-owned banks, improved a lot. The operation efficiency has reached a high level, while the intermediation performance need to be further developed. So, improving intermediation efficiency is the main area of bank improvement in the future. However, this paper only analysed 12 commercial banks in China and only one smaller sized regional bank is included in this research. This can be improved by adding more banks as sample banks to have a more precious conclusion.

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