

Efficiency Analysis of Cross-Border M&A of Chinese Banks—An Empirical Study Based on DEA Method

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Abstract. With the development of globalization, cross-border M&A is an important strategy for Chinese Banks to go abroad and achieve international operation. Therefore, the research on the efficiency of M&A is crucial. This paper selects nine cross-border M&A cases involving four commercial banks during 2006-2010, using data envelopment analysis (DEA) to conduct empirical research on the efficiency of Chinese banks before and after cross-border M&A. The results show that the benefits brought by cross-border M&A are a long-term benefit, while in the short term, it often leads to the reduction of bank's efficiency. In order to solve this problem, it is necessary to continuously integrate all aspects within the bank. At the same time, in recent years, cross-border M&A and the integration of Chinese banks have brought good benefits and make some achievement.

Introduction

Since the end of the 19th century, with the development of economic globalization, the western government has gradually relaxed the control of finance, and the international banking industry has started a strong wave of cross-border M&A. Today, we have experienced three waves of bank mergers and acquisitions. These activities have had a major impact on the international financial industry and the world economy. Especially since the 1990s, the development of financial integration process and information technology has provided strong support for the cross-border M&A of Banks. Many banks have quickly become the world's leading universal banks through cross-border M&A. Despite experiencing the financial crisis in 2007, these banks still firmly occupy the international market share due to their strong capital and risk tolerance. Meanwhile, a new round of competition in the global banking industry has begun, which is both an opportunity and a challenge for Chinese commercial banks.

Cross-border M&A by Chinese banks started late, initially beginning in the 1990s, when they were smaller. In 2001, China joined the WTO, the advanced service means, the standardized management concept and the higher credit rating of foreign banks have formed a strong competition with Chinese commercial banks. Until the end of 2006, the implementation of the Regulations on the administration of foreign banks marked the end of China's accession to the WTO. And China's banking sector is fully open to foreign capital, which is a great challenge for China's bank. In 2006, China's "Eleventh Five-Year Plan" put forward the strategy of "going out". Chinese enterprises have accelerated the pace of overseas expansion and have gone abroad to expand their business to other parts of the world. But there is no denying that there are huge differences between Chinese banks and foreign banks in terms of asset quality, profitability and innovation capability. Faced with

such situation, M&A is the most effective and rapid strategic measure for banks to achieve leaping development. Therefore, it is necessary for China's commercial Banks to expand and enhance international competitiveness.

The cross-border M&A of China's commercial banks have just started, there are many places to study, and good bank M&A efficiency is of great significance for achieving sustainable development. Based on the efficiency of cross-border M&A of Chinese banks, this paper analyzes the influencing factors by using the DEA method, and explores the relationship between cross-border M&A and operational efficiency of banks.

Model description

CRS Model

CRS(Scale return invariant model)is also a CCR model and it is the most basic model in DEA. This model assumes that N banks use K inputs to produce M outputs. For the i bank, they use x_i and y_i to represent inputs and outputs. Then the following two matrices can be formed:

$$x_i = (x_{1i}, x_{2i}, \dots, x_{Ki})', y_i = (y_{1i}, y_{2i}, \dots, y_{Mi})' \quad i = 1, 2, \dots, N \quad (1)$$

X, Y respectively represents $M \times N$ dimension input matrix and $M \times N$ dimension output matrix respectively. For every bank, we hope to measure the ratio of all outputs to all inputs, is $u' y_i / v' x_i$.

Here, u and v is the $M \times 1$ dimension output weight vector and the $K \times 1$ dimension input weight vector, it needs to be set by the model. Assuming constant scale returns, optimal weights can be obtained by solving the following mathematical problems:

$$\max_{u,v} (u' y_i / v' x_i) \quad (2)$$

$$s.t. \quad u' y_j / v' x_j \leq 1 \quad j = 1, 2, \dots, N$$

The above objective function is actually the weighted ratio of output and input of i bank. To avoid obtaining infinite solutions, the constraint $v' x_i = 1$ can be increased. The planning problem indicated above becomes:

$$\max_{\mu,v} (\mu' y_i) \quad s.t. \quad v' x_i = 1 \quad (3)$$

$$\mu' y_j - v' x_j \leq 0 \quad j = 1, 2, \dots, N \quad \mu, v \geq 0$$

Using the duality principle of linear programming, the equivalent envelope form of this problem can be obtained.

$$\min_{\theta,\lambda} \theta \quad s.t. \quad -y_i + Y\lambda \geq 0 \quad (4)$$

$$\theta x_i - X\lambda \geq 0 \quad \lambda \geq 0 \quad i = 1, 2, \dots, N$$

The θ is scalar, λ is $N \times 1$ constant vector, According to the definition of Farrell (1957), θ is i bank's efficiency, and $0 \leq \theta \leq 1$. When $\theta = 1$, it means that the bank is at the forefront of efficiency, so it is in a state of effective technology. The efficiency of each bank can be calculated by solving the linear programming N times.

The efficiency θ from CCR model is the technical efficiency TE. Its economic meaning is: When the output level of i bank remains constant, for example, taking the bank with the best performance in the sample as an example, it is the actual required ratio of investment.

VRS model

The assumption of constant returns to scale implicitly implies that small banks can increase the output scale by increasing the proportion of investment, that is, the size of the bank does not affect its efficiency. This assumption is obviously different from the actual one, which may lead to the combination of technical efficiency and scale efficiency when the investigated institutions are not all in the best scale. To solve this problem, Banker, Cooper (1984) assume variable returns and propose VRS model. When analyzing the bank's efficiency, the VRS model takes into account the effects of scale efficiency and distinguishes between the scale efficiency, so that a specific PTE (pure technical efficiency) can be derived.

By adding a convexity hypothesis $N' \lambda = 1$, the CCR model can be easily modified to be a BCC model:

$$\min_{\theta, \lambda} \theta \quad s.t. \quad -y_i + Y \lambda \geq 0 \quad (5)$$

$$\theta x_i - X \lambda \geq 0 \quad N' \lambda = 1, \quad \lambda \geq 0$$

According to the above derivation process, TE (technical efficiency) = PTE (pure technical efficiency) * SE (scale efficiency). Through the CRS model and VRS model, we can get the technical efficiency and pure technical efficiency of commercial banks, so as to calculate the scale efficiency.

Selection of Indicators

There is no unified definition of the definition of input and output of commercial banks. At present, the commonly used method for bank input and output in academia can be roughly divided into three types: production law, mediation law, and asset law. The production law believes that banks are producers of deposit accounts and loan services, so the input indicators are which can generate expenses, such as labor costs, fixed assets. Output indicators are items that can generate profits, such as the number of loans and deposits. The rule of mediation is to regard banks as intermediaries between capital demanders and capital providers in the market. Therefore, its input indicators are human cost and capital cost, and the output indicators are the amount of deposit and loan and the investment. Like intermediary law, banks in asset law are also regarded as financial intermediaries. However, the asset law strictly defines asset items in the bank's balance sheet as output, while its liabilities are defined as bank inputs.

There are defects in all of these methods. The production method only uses the number of deposit and loan accounts as input and output variables. It presupposes that each deposit account and each loan account have the same risk level, which is impossible to achieve. The intermediary law ignores the quality of the deposit and loan. When the proportion of bad loans in the loan is high or the stable balance in the deposit is low, it will bring a huge potential crisis to the bank when only using the proportion of the deposit and loan amount to measure the bank efficiency. It is generally believed that the mediation method is more suitable for analyzing the overall efficiency level of the company,

and the production method is more suitable for measuring the efficiency level of the branch office.

In summary, when selecting evaluation indicators, this paper does not rigidly adhere to the strict distinction between the input and output methods. Based on the advantages of various methods and considering the availability and practicability of data, We define the bank's input as labor, net fixed assets, and total deposits. Output is defined as the bank's operating income and total loans.

Sample selection and data sources

This paper selected 9 cases of cross-border M&A between 2006 and 2010, involving three state-owned commercial banks: ICBC, BOC, CCB. And a Joint-stock commercial bank: CMB. Specific cases are listed as follows. The data used are from the RESSET financial research database and the annual reports of commercial banks.

Table 1. Case of cross-border M&A by Chinese

M&A Party	Year	Target	M&A Share (%)
ICBC	2006.12	PT Bank Halim Indonesia	90
	2007.8	Seng Heng Bank	80
	2007.11	Standard Bank of South Africa	20
	2009.6	The Bank of East Asia	70
	2010.4	ACL Bank of Thailand	97.24
BOC	2006.12	Singapore Aircraft Leasing Enterprise	100
	2008.9	Rothschild Bank	20
CCB	2006.8	Bank of America Corporation(Asia)	100
CMB	2008.9	Hongkong Wing Lung Bank	100

Empirical Results and Analysis

The collected data are analyzed by DEA software and the results are as follows.

Table 2. The change of efficiency before and after M&A of ICBC

Year	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
2004	1.000	1.000	1.000
2005	0.908	0.938	0.968
2006*	0.903	0.996	0.907
2007*	1.000	1.000	1.000
2008	0.662	0.761	0.870
2009*	0.874	1.000	0.874
2010*	0.800	1.000	0.800

As can be seen from table 2, in the early 2003-2004 years, ICBC has a relatively good operating condition and is in a state of effective overall efficiency and scale efficiency. In 2005, the overall

technical efficiency declined, which resulted from two aspects of pure technical efficiency and scale efficiency. After the acquisition of Halim Bank in 2006, the overall downward trend continues, which is mainly due to the invalidity of the scale, indicating that there are some problems in the running-in of M&A. In November 2007, with the successful acquisition of the Standard Bank of South Africa by the ICBC, its technical efficiency, pure technical efficiency and scale efficiency have all reached the overall effectiveness. It not only completed the adjustment to the last year, but also expanded the business scale in South Africa, and gained the synergy of management. In 2008, the overall efficiency of ICBC declined, and its operating efficiency was poor. Then ICBC successively acquired the Bank of Canada and ACL Bank of Thailand in 2009 and 2010. Although these two acquisitions improved ICBC's purely technical efficiency and overall technical efficiency. However, as ICBC successively initiated overseas mergers and acquisitions during this period, it faced a complicated overseas market environment, and there were many aspects that needed to be integrated. Therefore, it did not reach the overall effective status.

Table 3. The change of efficiency before and after M&A of BOC

Year	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
2005	1.000	1.000	1.000
2006*	0.842	1.000	0.842
2007	1.000	1.000	1.000
2008*	0.857	0.761	0.857
2009	1.000	1.000	1.000
2010	1.000	1.000	1.000

As can be seen from table 3, The Bank of China managed well in the early years and achieved full efficiency in terms of overall technical efficiency and scale efficiency. In 2006, there was a case where the PE value was less than 1, which was due to invalid scale efficiency. In the following year, the Bank of China completed the integration of the acquisition enterprises and achieved the overall effectiveness. After the merger of France's Rothschild bank in 2008, the overall technical efficiency was invalid. After one year's integration, it quickly restored overall effectiveness and maintained it until 2010, which shows that this merger has brought positive benefits to the Bank of China.

Table 4. The change of efficiency before and after M&A of CCB

Year	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
2005	1.000	1.000	1.000
2006*	1.000	1.000	1.000
2007	0.875	1.000	0.875
2008	0.775	0.780	0.993
2009	1.000	1.000	1.000
2010	1.000	1.000	1.000

As can be seen from table 4, Before 2006, CCB was in a state of complete efficiency in terms of technical efficiency, pure technical efficiency and scale efficiency. But in the two years after the merger, the overall technical efficiency and pure technical efficiency have been declining. This may be due to many problems in the integration process after mergers and acquisitions, as well as the possible inadaptability to new overseas markets, so there is no synergy in the two years. From the data after 2009, these problems should have been solved reasonably, and the overall effectiveness has been achieved.

Table 5. The change of efficiency before and after M&A of CMB

Years	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
2006	1.000	1.000	1.000
2007	0.954	0.966	0.987
2008*	1.000	1.000	1.000
2009	0.601	1.000	0.601
2010	1.000	1.000	1.000

As we can see from the table 4-4, In 2006, the overall technical efficiency and scale efficiency of China Merchants Bank are all 1, and they are in an overall effective level. In 2007, the overall technical efficiency was in an invalid state. This was due to the inefficiency of both pure technical efficiency and scale efficiency. In 2008, China Merchants Bank resumed its overall effective state, but after one year of merger and acquisition, PE and SE reached 0.601, and the technical efficiency was low. This is mainly due to the poor management after M&A, and the failure to achieve rapid integration of human resources and corporate culture. According to the situation in 2010, China Merchants Bank has achieved the overall efficiency of scale efficiency and technical efficiency through a year's rapid integration, and successfully completed the acquisition of Wing Lung Bank.

Conclusions and Suggestions

The benefits of cross-board M&A are a long-term benefit, and in the short term, it often leads to the reduction of bank efficiency. At the beginning of cross-board M&A of China's commercial banks, all kinds of resources and manpower need to be matched and run in, so it is easy to have a negative effect on its efficiency.

In order to achieve long-term benefits, China's commercial banks need to continue to integrate overseas resources after M&A, and improve the internal management level, only through reasonable distribution and coordination can we finally achieve the goal of improving efficiency.

Overall, in recent years, cross-board M&A of commercial banks in China have brought good results, which has injected new vitality and vitality into China's commercial banks and promoted the development of China's banking industry. However, at the same time, commercial banks must also pay attention to preventing risks in their overseas expansion, identify their own positioning, combine the experiences of overseas advanced banks, and get out of our own way of M&A. If we can actively make use of the bank's cross-board M&A, it will effectively improve the competitiveness of our commercial banks and promote the internationalization of China's banking industry.

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