Research on Differences of Efficiencies of Chinese Commercial Banks

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Abstract. With the accelerated pace of the global economic integration and China's "Belt and Road" policy, the opening degree of China is gradually increasing. The tendency is obvious that Chinese banking industry is directly facing the competition pressure of the international mature financial market. Bank efficiency measures the effectiveness of bank input and output, reflecting the competitiveness of banks. Taking the seven-years data of ten commercial banks in China as the research object, this paper uses the relevant economic theory, data envelopment model and all elements efficiency model and analyses the operating efficiency and overall efficiency of each sample bank based on the method of deap to provide some constructive suggestions according to the analysis results.

Research Background and Significance

Banking plays an important role in the national economy. Bank efficiency measures the efficiency of input and output of banks, reflecting the competitiveness of banks to a certain extent. The efficiency of commercial banks directly affects the competitiveness of the incidence risk. The study of the factors that affect the efficiency of banks can not only provide technical support for the development of the banks, but also can provide a theoretical basis for the policy-making of financial regulatory institutions. It is the practical significance of this research.

Subject Theory Basis

The macro-control policy in China's market economy has a great impact on financial institutions, which comes from the national monetary policy, fiscal policy, credit environment and so on. A good credit environment plays a positive role in the management and efficiency promotion of commercial banks. The micro factors of the commercial bank mainly include the factors of the scale, asset allocation, asset quality, profitability, innovation capability and corporate governances.

Evaluation Method of Commercial Bank Efficiency

DEA Theory. DEA (Data Envelopment Analysis) is applied to evaluate the relative efficiencies of several units with multi input and output departments. DEA method can be used to judge the relative locations of the decision units and the efficient production by the linear programming method, but also can reflect many valuable management information, which is one of the best methods in terms of application scope and effect.

DEA Model. Assume there are n commercial banks. We select p input indicators and q output indicator. X_{ik} and Y_{jk} respectively represent the i th input indicator and j th output indicator of the k th commercial bank. v_i represents the i th input; the u_j represents the j th output; w_0 represents the relative efficiency. The CRS model is shown as follows:

$$\left\{ \begin{array}{l} \max : w_0 = \frac{\sum_{j=1}^q u_j y_{j0}}{\sum_{i=1}^p v_i x_{i0}} \\ \text{s. t.} \quad \frac{\sum_{j=1}^q u_j y_{jk}}{\sum_{i=1}^p v_i x_{ik}} \leq 1 \\ v_{ji} \geq \varepsilon \\ k=1,2,\dots,n \\ r=1,2,\dots,q \\ i=1,2,\dots,p \end{array} \right.$$

The VRS model expresses the technical efficiency as the product of the scale efficiency and pure efficiency. The model is as follows:

$$\left\{ \begin{array}{l} \max : w_0 = \frac{\sum_{j=1}^q u_j y_{j0} - u_0}{\sum_{i=1}^p v_i x_{i0}} \\ \text{s. t.} \quad \frac{\sum_{j=1}^q u_j y_{jk} - u_0}{\sum_{i=1}^p v_i x_{ik}} \leq 1 \\ v_{ji} \geq \varepsilon \\ k=1,2,\dots,n \\ r=1,2,\dots,q \\ i=1,2,\dots,p \end{array} \right.$$

Malmquist Model. The Malmquist index method integrate the indicator data with the DEA model to conduct the all elements analysis to measure the gap between the practical value and the optimal value. It is a dynamic analysis method. According to the distance function,

$$d^t(x, y) = \min \left\{ \theta : \frac{y}{\theta} \in U(x) \right\}$$

We deduce the Malmquist efficiency transformation formula:

$$M_0^{t,t+1}(x_{t+1}, y_{t+1}, x_t, y_t) = \frac{d_0^{t+1}(x_{t+1}, y_{t+1})}{d_0^t(x_t, y_t)} \times \left[\frac{d_0^t(x_{t+1}, y_{t+1}) \times d_0^t(x_t, y_t)}{d_0^{t+1}(x_{t+1}, y_{t+1}) \times d_0^{t+1}(x_t, y_t)} \right]^{\frac{1}{2}}$$

Among the above formula, the $M_0^{t,t+1}(x_{t+1}, y_{t+1}, x_t, y_t)$ is the efficiency transformation indicator; x and y respectively represent input and output indicators; t and $t+1$ represent the analysis indicator periods. $d_0^{t+1}(x_t, y_t)$ is the efficiency level of the period of $t+1$ for the reference of period of t . Therefore, when M is bigger than one, the efficiency is increasing; when M is smaller than one, the efficiency is decreasing; when M equals to one, the efficiency has no change.

Selection Method of Input and Output Indices. The production method, the intermediary method, the asset method and the added value method are the common selection method of input and output indices. Taking full account of the development characteristics of China's commercial banks, this paper selects the total assets, total deposits and operating income as input indicators, and the total loans and the profit before tax as output indicators.

Analysis of Commercial Bank Efficiency

Samples and Indices Selection. Taking ten big commercial banks in China as the sample, we select the indicator data from 2010 to 2016 to do the research. The collected data in the paper comes from the Wind database, the website of national data and the annual reports of the sample commercial banks.

Table 1. Descriptive statistics of the variables (unit: billion Yuan)

	Variable	Index	Average	Standard deviation	Maximum value	Minimum value
Input variables	X1	Total assets	8598.631	6372.826	24137.265	727.61
	X2	Total deposits	6261.346	4936.904	162894.219	562.912
	X3	Business income	257.328	199.135	697.647	18.022
Output variables	Y1	Total loans	4467.904	3503.336	13056.85	407.391
	Y2	Pretax profit	150.3629	220.62	1751.56	7.998

Analysis of Sample Efficiency Based on DEA Model. According to the DEA model in the third chapter, we use the Deap2.1 software to analyze the sample data categorized by the year. The analysis results are shown in Table 2, Table 3 and Table 4.

Table 2. Technical efficiency transformation of the Chinese commercial banks from 2010 to 2016

Name	Year								Average
	2010	2011	2012	2013	2014	2015	2016		
Industrial and Commercial Bank of China		0.843	1	1	1	1	1	1	0.978
China Construction Bank		1	1	1	1	1	1	0.975	0.996
Bank of Communications		1	1	1	1	1	1	0.830	0.976
Agricultural Bank of China		0.764	0.820	0.842	0.889	0.901	0.903	0.943	0.866
Pingan Bank		0.952	1	0.906	0.881	0.843	0.885	0.839	0.901
Shanghai Pudong Development Bank		0.909	1	1	0.950	0.984	1	0.920	0.966
Industrial Bank		0.972	1	1	1	1	1	0.853	0.975
China Merchants Bank		1	0.982	1	1	0.982	1	0.930	0.985
Bank of China		0.965	1	0.982	0.994	1	1	1	0.992
China Citic Bank		1	1	1	0.967	0.954	0.957	0.932	0.973

Table 3. Pure technical efficiency transformation of the Chinese commercial banks from 2010 to 2016

Name	Year							
	2010	2011	2012	2013	2014	2015	2016	Average
Industrial and Commercial Bank of China	1	1	1	1	1	1	1	1
China Construction Bank	1	1	1	1	1	1	0.983	0.998
Bank of Communications	1	1	1	1	1	1	0.979	0.997
Agricultural Bank of China	0.851	0.869	0.870	0.889	0.902	0.904	0.947	0.890
Pingan Bank	1	1	1	1	1	1	1	1
Shanghai Pudong Development Bank	0.920	1	1	0.991	1	1	1	0.987
Industrial Bank	1	1	1	1	1	1	1	1
China Merchants Bank	1	1	1	1	1	1	1	1
Bank of China	1	1	1	1	1	1	1	1
China Citic Bank	1	1	1	1	1	1	1	1

Table 4. Scale efficiency transformation of the Chinese commercial banks from 2010 to 2016

Name	Year							
	2010	2011	2012	2013	2014	2015	2016	Average
Industrial and Commercial Bank of China	0.843	1	1	1	1	1	1	0.978
China Construction Bank	1	1	1	1	1	1	0.991	0.999
Bank of Communications	1	1	1	1	1	1	0.847	0.978
Agricultural Bank of China	0.897	0.944	0.969	0.999	0.999	0.998	0.996	0.972
Pingan Bank	0.952	1	0.906	0.881	0.843	0.885	0.839	0.901
Shanghai Pudong Development Bank	0.989	1	1	0.959	0.984	1	0.920	0.979
Industrial Bank	0.972	1	1	1	1	1	0.853	0.975
China Merchants Bank	1	1	1	1	0.982	1	0.930	0.987
Bank of China	0.965	0.982	0.982	0.994	1	1	1	0.989
China Citic Bank	1	1	1	0.967	0.954	0.957	0.932	0.973

Analysis of Sample Efficiency Based on Malmquist Model. According to the Malmquist model in the third chapter, we use the Deap2.1 software to analyze the sample data categorized by the year. The analysis results are shown in Table 5.

Table 5. Average all elements indicators of Chinese commercial banks from 2010 to 2016

Time	Indicator				
	Technical efficiency	Technical progress	Pure technicalefficiency	Scaleefficiency	All elementsefficiency
2010-2011	1.044	0.817	1.011	1.033	0.853
2011-2012	0.993	0.983	1.000	0.993	0.975
2012-2013	0.995	1.048	1.001	0.994	1.043
2013-2014	0.998	0.962	1.002	0.996	0.960
2014-2015	1.009	0.975	1.000	1.008	0.984
2015-2016	0.945	1.105	1.001	0.944	1.045

Conclusion

This paper uses relevant theories and models, takes the ten commercial banks in China as samples, selects 350 indicators in seven years and analyses the operating efficiency and overall efficiency of each sample bank based on the method of deap. The results show that there are obvious differences among the banks in terms of technical efficiency and scale efficiency, and the overall efficiency of Chinese bank is significantly affected by technological progress. According to the analysis of the results and the reasons, this paper puts forward some suggestions as follows for the development of commercial banks in China. First, to improve the sensitivity to the macroeconomic environment; second, appropriately control the asset size; third, to enhance the technical level of business.

References

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