China City Commercial Bank Based on Network DEA Empirical Study of Operational Efficiency

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Abstract: This paper studies the present situation of the development of urban commercial banks in China by using the method of integrated network DEA, and draws the following conclusions: First, the overall development situation of urban commercial banks in China is good. Second, urban commercial banks should pay attention to the overall development, pay attention to the interaction between different businesses; The scale of the third city commercial bank has no decisive influence on the management efficiency of the city commercial bank. The city commercial bank should pay attention to the profitability and maintain the product advantage. Fourth, the development of local economy has a very important impact on the development of urban commercial banks.

1. Research Background

From the previous urban credit cooperatives to urban commercial banks, China's urban commercial banks have undergone many major reforms, such as mergers and acquisitions, cross-regional operations, and so on. China's urban commercial banks started late and developed rapidly, and they have made a qualitative leap in asset scale, business operation and risk management. At present, as a representative of China's regional banks, city commercial banks have become the main force in China's regional financial industry, and the steady and rapid development has made the importance of city commercial banks in China's banking industry increasingly increasing.

For regional economic development, the support given by city commercial banks may sometimes exceed large commercial banks. Because for the developing small and medium-sized enterprises, the credit conditions of large commercial banks are very demanding, it is difficult for small and medium-sized enterprises to seek development funds here. Unlike urban commercial banks, it has a preferential loan policy for local enterprises. Providing a convenient fund pool for the development of local enterprises. City commercial banks have also promoted regional economic development while helping enterprises develop. In recent years, some city commercial banks have developed rapidly. In addition to local operations, they have also opened branches in other cities to expand their business scope and scale. According to the data of the China Banking Regulatory Commission, as of 2017, there are 134 city commercial banks in China, with 420,000 employees, assets of 31.7 trillion yuan, non-performing loan ratio of 1.52%, and asset profit margin of 0.83%. The rate is 12.75%. From these data, we can see that the development of China's city commercial banks is very rapid and the indicators are obviously improved. At the same time, many city commercial banks queued up to show the vitality of China's city commercial banks. According to the information released on the website of the China Securities Regulatory Commission, as of the end of 2017, the number of existing commercial banks in listed cities in China has reached 17.

Although the development trend of China's urban commercial banks is very good, China's economic environment is complex, the economic development of various regions is not balanced, and the development level of local commercial banks is also very different. In the face of the impact

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of all parties, the development of city commercial banks is still greatly challenged. In this regard, city commercial banks also need to work hard to improve operational efficiency and enhance comprehensive competitiveness. Only continuous improvement can achieve sustainable development.

2. Literature Review

Charnes et al. (1978) was the first scholar to use the DEA model to measure bank efficiency, opening up a new field of bank efficiency research.

Färe and Grosskopf (1996) first proposed the concept of network DEA, which provided a new idea for the efficiency research of commercial banks.

Wang et al. (2014) measured the efficiency of 16 Chinese commercial banks by using the network DEA model. The research results show that during the third round of banking reform, the main reason for the inefficiency of China's commercial banks was the “carrying” phase of bank funds. Therefore, the control of non-performing loans made the efficiency value of this stage significantly improved. At the same time, the shareholding system The reform has a significant effect on the operational efficiency of state-owned commercial banks.

Zha et al. (2016) used SBM dynamic two-stage network DEA model to study commercial banks in China, focusing on the impact of non-performing loans on bank efficiency, and giving different stages and different periods of the model. Different weights. The results show that if the impact of non-performing loans is neglected, the bank's operating efficiency will be underestimated; and the reason why the commercial bank's efficiency value is less than 1 is mainly caused by the efficiency value of the production and profit stage.

Abid and Goaied (2017) mainly studied the profitability of banking industry in the Middle East and North Africa. Through the use of cutting-edge analysis, it was found that the profit efficiency of banks in different countries was different. The technology gap was the most important factor affecting the competitiveness of banks in various countries.

Zhao Ziliao (2016) combined the actual situation of China's commercial banks, divided the business process into three sub-processes, and evaluated the operational efficiency of China's commercial banks by establishing a network DEA model based on constant scale returns, and found that compared with the independent DEA model. The network DEA has more advantages in the technical efficiency evaluation of commercial banks.

Liu Debin (2017) divides the internal operation process of China's commercial banks into four sub-stages by adopting the network DEA method. It is found that there are significant differences in the efficiency values of the listed commercial banks in China, but the efficiency of banks in Phase II is generally higher. The efficiency value of phase III is generally low, and the overall efficiency value is low, indicating that the income-generating capacity of China's commercial banks needs to be improved.

Chen Chen and Tian Zhisheng (2018) found through research that the operational efficiency of China's urban commercial banks is closely related to the regional GDP level. City commercial banks should formulate their own development strategies according to their own characteristics.

3. Empirical Analysis of the Operational Efficiency of Chinese City Commercial Banks

3.1 Integrated Network DEA Model.

From the perspective of input and output, this paper divides the business process of city commercial banks into two stages: the first stage is mainly the bank's liability business and intermediary business, which accumulates funds for banks; the second stage is mainly asset business, which is bank Generate revenue. The intermediate business output is the independent output of the first stage. The bank's own funds are separate inputs for the second phase.

There are n network structure DMU, and DMU's input-output is$(x_{1k},y_{1k},z_k,x_{2k},y_{2k})$,The input and output of DMUk$(1\leq k\leq n)$ in stage S_1 are$(x_{1k};y_{1k},z_k)$,In stage S_2, the input and output

are(z_k,x_{2k};y_{2k}).

$$(P)\begin{cases}\min \theta_1+\theta_2\\ s.t.\ \sum_{k=1}^{n} x_k^1\rho_k^1 \le \theta_1 x_0^1\\ \sum_{k=1}^{n} z_k\rho_k^1 \ge \theta_2 z_0\\ \sum_{k=1}^{n} y_k^1\rho_k^1 \ge y_0^1\\ \sum_{k=1}^{n} x_k^2\rho_k^2 \le \theta_2 x_0^2\\ \sum_{k=1}^{n} z_k\rho_k^2 \ge \theta_2 z_0\\ \sum_{k=2}^{n} y_k^2\rho_k^2 \ge y_0^2\\ (\rho_k^1 \ge 0, \rho_k^2 \ge 0, k=1,\cdots,n)\end{cases} \tag{1}$$

The CCR model of stage S_1 is

$$(P^1)\begin{cases}\min \theta_1\\ s.t.\ \sum_{k=1}^{n} x_k^1\rho_k^1 \le \theta_1 x_0^1\\ \sum_{k=1}^{n} z_k\rho_k^1 \ge z_0\\ \sum_{k=1}^{n} y_k^1\rho_k^1 \ge y_0^1\\ (\rho_k^1 \ge 0, k=1,\cdots,n)\end{cases} \tag{2}$$

The CCR model of stage S2 is:

$$(P^2)\begin{cases}\min \theta_2\\ s.t.\ \sum_{k=1}^{n} x_k^2\rho_k^2 \le \theta_2 x_0^2\\ \sum_{k=1}^{n} z_k\rho_k^2 \ge \theta_2 z_0\\ \sum_{k=2}^{n} y_k^2\rho_k^2 \ge y_0^2\\ (\rho_k^2 \ge 0, k=1,\cdots,n)\end{cases} \tag{3}$$

Let the optimal solution of (P) be $\theta_1, \theta_2, \rho^1, \rho^2$ The optimal solution of model (P1) is θ^1和 ρ^1,The optimal solution of model (P2) isθ^2, ρ^2.

3.2 Indicator Selection and Data Source.

(1)Method of index selection .The selection of input-output indicators in this paper mainly combines the following three methods: Production method. The production method treats the bank as a special production enterprise. The cost is labor and bank capital. The output is the number of deposit accounts and the number of loans. The limitation of the production method is that the output

is only defined as the number of financial services, regardless of the amount. The definition of output is obviously not comprehensive and appropriate. Intermediary law. The intermediary law treats the bank as an intermediary between the fund supply and demanders and the capital demanders. The bank absorbs customer deposits and then converts the deposits into loans and investments to generate income. In the intermediary law, the operating costs such as labor, fixed assets, deposits, and interest expenses are mainly input; the output is defined as deposits and loans, so in the intermediary law, deposits are both inputs and outputs. Asset Law. The asset law mainly defines the input-output indicators according to the contents of the balance sheet, and uses the bank's labor force, fixed assets, and deposit assets as input indicators, and uses loans and investments as output indicators. Due to the nature of the asset law, it cannot consider the financial services provided by banks, and it also has certain defects.

(2)Determination of indicators. Using the DEA method to measure the efficiency of China's urban commercial banks, the input and output indicators are highly flexible. This paper combines the above points and selects the input and output indicators of the model.

Table 1 Definition of input-output indicators

The index type	Name	Instructions
S_1 input	Fixed costs	The difference between the total fixed assets at the end of the year and the total fixed assets at the beginning of the year
	Variable costs	Total operating expenses for the year, including business tax, business and management fees (including staff expenses) and asset impairment losses
S_1 output	Intermediate revenue	Net commission and commission income
	Liability business output	Bank deposits, loans from commercial Banks to the central bank, and interbank loans between commercial Banks
S_2 input	Liability business output	Bank deposits, loans from commercial Banks to the central bank, and interbank loans between commercial Banks
	Bank's own funds	Net worth
S_2 output	Interest income	Net interest income
	earnings	Return on investment

(3)Empirical results and analysis. This paper takes the relevant data of 17 listed city commercial banks in China as samples in 2017, and substitutes the selected input indicators and output indicators into the two-stage integrated network DEA model, and uses DEAP 2.1 software to calculate the phased efficiency value of commercial banks in China's listed cities. The overall efficiency value and the two-stage correlation index were empirically analyzed. The calculation results are shown in Table 2. Table2 shows the efficiency value P1 of phase one, the efficiency value P2 of phase two, and the overall efficiency value P calculated by the integrated network DEA model. Among the 17 sample banks, only Jiangsu Bank, Nanjing Bank, Ningbo Bank, Qingdao Bank, Nanjing Bank, and Chongqing Bank are effective in the network DEA. The efficiency values of Bank of Beijing, Gansu Bank and Shanghai Bank are effective in Phase 1. The weak DEA is implemented, and all the decision units of other banks are in the invalid state of the network DEA. In banks with overall efficiency values ineffective, Bank of Beijing, Gansu Bank and Bank of Shanghai Phase 1 have the highest efficiency values, all of which are valid for weak DEA. In banks with overall efficiency values that are ineffective, DEA is not effective in Phase 2. . As can be seen from Figure 4.3, the efficiency value of each bank's sub-phase is roughly consistent with the overall efficiency value. The Guiyang Bank with the lowest overall efficiency value, the efficiency values of Phase 1 and Phase 2 are the lowest among the sample banks. Correlation index comparison. The correlation index is the interaction between two sub-phases in the model that affects the overall efficiency value of the sample. There are only 3 banks with a correlation index of 1, namely Bank of Beijing, Jiangsu Bank and Qingdao Bank, which means that the interaction between the two sub-phases of the three banks is effective, which is exactly the two banks of Jiangsu Bank and Qingdao Bank. One of the reasons for the highest average efficiency value of the stage, and the

Bank of Beijing's low efficiency value is mainly because its efficiency value in stage 2 is very low. Among the 17 listed city commercial banks, Shanghai Bank's correlation index is the lowest, followed by Hangzhou Bank and Huishang Bank, so the overall efficiency of these three banks is not high.

Through the above empirical analysis, we can draw the following conclusions: First, the size of the bank has a certain impact on the efficiency of city commercial banks. When the bank is small, the growth of scale has a significant positive effect on the bank's operating efficiency, but it does not mean that the bank should expand the asset scale. Although China's urban commercial banks are basically in the state of economies of scale, it is never wise to blindly expand the absolute amount of total assets. Banks must focus on asset quality in order to develop healthily. And in the theory of economies of scale, the average cost of banks changes in a “U” shape. Once the bank reaches the optimal production scale with the lowest average cost, then expanding the scale will only cause the average cost to rise, and the bank efficiency will inevitably be negative. influences. Especially for the regional banks with strong regional commercial banks, the business scope of the franchise is expanded in different places, and the incidental operational risks are quite high. We should focus on developing local resources and carefully expanding. Second, profitability is positively related to bank efficiency. The stronger the profitability of the bank, the higher the profit, the stronger the capital strength, the more surplus and high salary, the higher quality of the labor force, the attracting of senior management, which is conducive to the improvement of the bank management level; the same, the high profitability Banks can invest more resources in research and development of new products, attract more customers and increase market share. The improvement of profitability is obviously very beneficial to the improvement of bank operation efficiency. Third, GDP in the region has a positive impact on the operational efficiency of urban commercial banks. A very prominent advantage of city commercial banks compared to other banks is the support from local governments and enterprises. For city commercial banks, local enterprises are very important shareholders. For local enterprises, city commercial banks provide great financial convenience for the development of enterprises, and the two complement each other. For the government, the development of urban commercial banks is conducive to the improvement of local image, and it also helps the local economic development. For city commercial banks, with the support of local governments, they can enjoy more preferential policies. It is obviously very advantageous for the development of the bank. Therefore, the GDP of the region has a positive correlation with urban commercial banks.

Table 2 Bank efficiency value and correlation index

Bank	P_1 θ	P_2 θ	P $\theta_1+\theta_2$	Association index
Beijing Bank	1	0.777476	1.777476	1
Chengdu Bank	0.788934	0.772658	1.561592	0.834519
Gansu Bank	1	0.899953	1.899953	0.930599
Guiyang Bank	0.735825	0.720652	1.456477	0.881235
Harbin Bank	0.888564	0.85963	1.748194	0.868013
Hangzhou Bank	0.801879	0.776521	1.578400	0.714967
Huishang Bank	0.872268	0.84586	1.718128	0.739327
Jiangsu Bank	1	1	2	1
Jinzhou Bank	0.962332	0.950052	1.912384	0.849879
Nanjing Bank	1	1	2	0.923876
Ningbo Bank	1	1	2	0.962117
Qingdao Bank	1	1	2	1
Shanghai Bank	1	0.850845	1.850845	0.713051
Shengjing Bank	0.985944	0.968208	1.954152	0.802903
Tianjin Bank	1	1	2	0.786207
Zhongyuan Bank	0.879106	0.852281	1.731387	0.786509
Chongqing Bank	1	1	2	0.873384
Mean	0.936168	0.898479	1.834646	0.862740

4. Policy Suggestion

For banks, security is always the first priority. City commercial banks should establish their own risk management system according to their own characteristics. Improve risk management awareness, improve risk detection system, strive to avoid risks, identify risks and timely warning before risks come, correctly assess risks when risks come, and deal with risks scientifically to minimize losses. A strict risk management system can not only improve the security of banks, but also improve the quality of banks in terms of capital, which is conducive to the healthy development of banks. Therefore, in the process of supervision, the supervisory department should give full play to its pre-existing supervision duties and strictly supervise the city commercial banks. All city commercial banks are for profit. From the perspective of the internal perspective of city commercial banks, improving asset quality and optimizing asset structure can enhance the bank's profitability, further improve bank operation efficiency and promote bank development. At the same time, city commercial banks should give full play to their own advantages and strive to develop local resources. In terms of financial services, it is possible to provide more financing opportunities to local SMEs as much as possible within a safe range. In the last chapter, we mentioned that urban commercial banks and local enterprises complement each other and promote the development of small and medium-sized enterprises, which not only improves the bank's profitability, but also facilitates the long-term development of the bank. In terms of absorbing depositors, city commercial banks are not as good as state-controlled banks and joint-stock commercial banks. They have a long history and strong credibility, and they firmly occupy market share.

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