HK.NCCP
International Journal of Intelligent Information and Management Science
ISSN: 2307-0692 *Volume 2, Issue 6, August 2013*

Research on Scale Economy and Management Effect of Chinese Banking Industry

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Abstract: After introducing management level variable into the cost function of banks, we can set up an empirical model to estimate the scale economy of the banking industry in China. The result shows that the increasing of the bank scale is an important source for scale diseconomy under certain management level. On the whole, if management level is settled, the banking industry of our country is in the state of diseconomies of scale and the improving of management level will bring the average cost down.

Keywords: **Management Level; Scale Economy; Chinese Banking Industry**

1. Introduction

Scale economy, is the state of average cost coming down and economic performance improving due to the increasing of scale of an economic organization. Scale economy of the banking industry comes from the amortization of the fixed cost and specialization. The occurrences of diseconomies of scale may be because the cost due to management problem counteracts the scale economy during the production. Consequently, scale economy of a commercial bank is closely related with its internal management level, and there is a need to introduce a management factor variable to make deeper analysis.

2. Literature Review

Researches abroad discovered that the average cost curve is a U style [1], which means that small banks have increasing returns to scale and big banks have unchanged or a little decreasing returns to scale [2]. On the whole, the effect of scale economy achieved through increasing bank scale is not obvious. By contraries, correlative data shows that the increasing of scale may bring diseconomies, which is because of the management difficulty of big banks due to their disperse territories.

Recent years, most Chinese scholars studying scale economy of banks used the financial index analysis method, such as operation efficiency index and cost index. In the last two or three years, some of them have already tried quantitative analysis models, such as DEA(Data Envelopment Analysis), translog cost function and Box-Cox Transformation [3].

Yu Liangchun and Ju Yuan used the Harvard School "structure—behavior--performance" analysis normal formulas to do comparative studies on operation efficiency index and cost index of commercial banks in our country. They pointed out that the earning capacity and operation performance in emerging small banks are obviously better than that in the four major state-owned commercial banks. Costs in the four major state-owned commercial banks are not getting lower due to advantage of scale [4].

The recent research by Yu Liangchun and Gao Bo proved that scale economy does exist in our banking industry, though it is in banks with moderate scale, not in the biggest ones [5]. Another empirical research made quantitative analysis on the data from 1994 to 1999 of state-owned commercial banks and 10 joint-stock commercial banks, by the means of translog cost function and Box-Cox Transformation. The results showed that banks with bigger scale have high-leveled scope economy, and the four major state-owned commercial banks do better in scope economy than emerging joint-stock commercial banks.

Besides, some scholars did research on scale economy of commercial banks in China by the method of DEA. Conclusions differ among different scholars, but on the whole, there is a correlation between scale economy and internal management level of banks. Consequently, we need to introduce management factors into the measure of bank efficiency [6]. A few scholars introduced management factors into production function[7], and here we will introduce management factors into the cost function of banks to build a relevant model to get new view of scale economy in our banking industry based on their work.

3. Basic Model

We define y as the output of commercial banks, m as corresponding management level. Then the cost function

of commercial banks can be defined as $C = C(y, m)$, and accordingly, the average cost function can be expressed as follows.

$$\ln AC(y,m) = a_0 + ay \ln y + \frac{1}{2} a_{yy} (\ln y)^2 + a_{ym} \ln y \ln m + a_m \ln m + \frac{1}{2} a_{mm} (\ln m)^2$$

(1)

With decided management level, the scale economy (output scale elastic coefficient) can be calculated by the following formula [8].

$$\xi_y = \frac{\partial \ln AC}{\partial \ln y} = \frac{\partial AC}{\partial y} \bullet \frac{y}{AC} = \frac{MC}{AC} - 1$$

(2)

In the formula, y is replaced by profitable assets index. If $\xi_y \le 0$, scale economy exists, which means that the average cost curve appears descending. If $\xi_y \ge 0$, the situation is just the opposite. We can get the following formula from (1) and (2),

$$\xi_y = a_y + a_{yy} \ln y + a_{ym} \ln m$$

(3)

If $a_{ym} < 0$, it means ξ_y will decrease as m increases, when the quantity of output is decided. When the average cost curve is downward sloping, it has a high slope coefficient. And when it is upward sloping, a high slope coefficient. Meanwhile, we define the economics of scale as y_0.We can draw a formula from (3).

$$\ln y_0 = \frac{a_y + a_{ym} \ln m}{a_{yy}}$$

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Suppose $a_{yy} > 0$, the quantity of output will increase as m increases. In the case of $a_{ym} < 0$ and $a_{yy} < 0$, the average cost curve is as the figure 1 shows. In the figure 1, $m_0 < m_1$.

It's worth noticing that there are two sources of diseconomies of scale, low management level (when $a_{ym} < 0$) and high output scale(when $a_{ym} > 0$). Consequently, diseconomies of scale can be classified as diseconomies due to increasing scale and diseconomies due to low level management.

$$\xi_m = \frac{\partial \ln AC}{\partial \ln m} = a_m + a_{ym} \ln y + a_{mm} \ln m$$

(4)

We can calculate the economy of scale (output scale elastic coefficient). In a similar way, we can work out the management level elastic coefficient through the equation (3), which will show how the cost decreases due to management level changes.

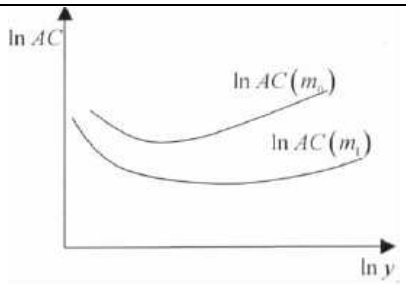

Figure 1. The Curves of Average Cost with Different Management Levels.

4. Data, Demonstration Model and Analysis Results

Here we choose the data from 2007 to 2009 of 13 domestic commercial banks for sample, which are Industrial and Commercial Bank of China, Bank of China, Construction Bank, Agricultural bank, Bank of Communications, Huaxia Bank, Industrial Bank, Minsheng bank, Merchants Bank, Shenzhen Development Bank, CITIC Industrial Bank, Everbright Bank and Shanghai Pudong Development Bank.

The average cost function of the banking industry in our country can be estimated by the empirical form of equation (1),

$$\ln AC_{it} = a_0 + \gamma_t + a_y \ln y_{it} + \frac{1}{2} a_{yy} (\ln y_{it})^2 + a_{ym} (\ln y_{it}) \bullet m_{it} + a_m m_{it} + \frac{1}{2} a_{mm} (m_{it})^2 + \xi_{it}$$

(5)

In the formula above, i =1, …, 13, represents different commercial banks, t =1, 2, 3, represents the year 2007, 2008 and 2009, γ_t represents time effect, and ξ_{it} represents random error term which follows the normal distribution.

We can use profit efficiency index instead of the measure of management level. The profit efficiency index can be measured through the following function,

$$\ln(P_{it} / K_{it}) = \beta_0 + \beta_1 \ln(FA_{it} / K_{it}) - \mu_{it} + v_{it}$$

(6)

In the formula above, i =1,…, 13; t =1,…, 3; P_{it} represents the profit of bank in the t year. Considering the non-performing loan difference due to historical reason, we use the operating profit before provision which can reflect the bank profitability accurately. FA_{it} represents the physical capital input in the t year of the i bank. FA_{it} represents the equity capital in the t year of the i bank. In $\mu_{it} = \mu \exp[-\eta(t-T)]$, μ_{it} is a nonnegative random variable following the Normal Distribution $N(\mu, \sigma_\mu^2)$.η is the parameter to be estimated, while T is

the reference time. Suppose if v_{it} follows the normal distribution. Considering the different property and profit scales due to different bank scales, we carries on standardized processing to the data.

Define combination variance $\sigma^2 = \sigma^2_{\mu} + \sigma^2_{v}$, so the proportion of inefficient variance in the combination variance is $\gamma = \frac{\sigma^2_{\mu}}{\sigma^2_{\mu} + \sigma^2_{v}}$. The efficiency which the equation (6) defined can be worked out through the equation below,

$$EFF_i = \frac{E(P_{it}^{*} \mid \mu_i FA_{it}, K_{it})}{E(P_{it}^{*} \mid \mu_i = 0, FA_{it}, K_{it})} \quad (7)$$

In this equation, is the estimated operating profit value of the i bank before provision in the t year. EFF_i is situated between 0 and 1.

The profit efficiency may become a simple proxy variable of the management level, however, as the profit efficiency's measuring errors may bring estimate errors to the parameters in the equation (5), because that the profit efficiency level may be related with random error terms. Consequently, we take the sequence of the profit efficiency as proxy variable of the management level, which means measuring errors can only influence the measured value, not their sequence. Results after linear regression are showed in the table 1.

The adjustment Goodness-of-Fit of the regression equation is 0.6932, which indicates that the equation (5) after has reasonably reflected the bank average cost after introducing management level variable. The output variable coefficient ($a_y < 0$ and $a_{yy} > 0$) indicates that the average cost curve is U style when the management level is decided, which means that diseconomy of technical scale will increase when the scale increases. Meanwhile, the interaction of output and management level is obviously negative, which means that scale economy will grow when management level is improved.

Then each Commercial bank's management level elasticity coefficient can be estimated through the formula (4). Table 2 enumerates the general statistical value (average value, standard deviation, minimum value and maximum value) of the above scale elastic coefficient and the management level elasticity coefficient. From table 2 it can be seen that on the whole, the scale elasticity coefficient of commercial banks in our country is positive, which means that the Chinese banking industry is in the state of diseconomies of scale under the existing management level, and the management level elasticity coefficient is negative, which means that the promotion of management of the banking industry in our country will bring down the average cost under the existing scale level.

Table 1. Linear Regression Results of the Average Cost Function of the China Banking Industry

variable	Parameter	coefficient	Inaccuracy	T	$P_r > \|t\|$
intercept	a_0	3.86546	3.9606	0.91	0.3632
total earning assets	a_y	-0.79621	0.4878	-1.47	0.1421
total earning assets* total earning assets	a_{yy}	0.04687	0.0316	1.18	0.2236
management level	a_m	-2.87654	0.8159	-3.25	0.0024
management level *management level	a_{mm}	-0.24577	0.0814	2.79	0.0063
total earning assets *management level	a_{my}	-0.16824	0.0517	2.98	0.0037
D2008	a_{08}	0.38797	0.0373	7.69	<0.0001
D2009	a_{09}	0.20076	0.0361	6.58	<0.0001

Table 2. Scale Level Elastic Coefficient and Management Level Elastic Coefficient of the Banking Industry in our Country.

	average	standard deviation	minimum	max
scale elastic coefficient	0.013625	0.076203	-0.17572	0.14824
management level elastic coefficient	-0.11437	0.147627	-0.36448	0.20328

5. Conclusion

Empirical analysis shows that the increasing of bank scale is an important source of diseconomies of scale when management level is decided [9]. On the whole, the banking industry in China is in the state of diseconomies of scale, and the improving of bank management level will reduce the average cost. Consequently, the management level of banking industry demands a promotion in order to reduce cost and increase profits.

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