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An Empirical Analysis of Chinese Commercial Banks' Efficiency and Influencing Factors

—Under the Constraint of Non-Performing Loans

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Abstract

This article is based on the SBM-Undesirable model to measure and decompose the technical efficiency of commercial banks from 2003 to 2014, and based on panel date to decompose its affecting factors. Our research shows: Since the banking began to reform from 2003, technical efficiency and pure technical efficiency have been significantly increased, the efficiency of scale also had obvious improved before 2008, thereafter growth is more gentle, and even state-owned banks are experiencing a downward trend. Reform impact is more consistent for different types of banks, basically promoting the improvement of the efficiency of the bank. With the advance of market interest rates, internal factors such as management, business innovation become the key to enhance the efficiency of banking sector. If the banks do not continue to reform and still blindly expand the scale of assets, they will not get higher efficiency.

1. Introduction

Since the 1990s, dramatic changes have taken place in the market structure and the operating situation of Chinese banking, along with the going on of the financial sector reform. Especially after 2000, with the banking stripping non-performing loans and continually moving to capital market, the banking sector continues to improve its operating performance, "vast fortune" even leads to public discontent. However, the indirect financing

still occupies a large proportion of total social financing, and the operating conditions of the banking sector will not only influence the entire financial sector, but also have a stake in the entire national economy. Considering the above, the efficiency of commercial banks has become the focus of sustained attention in academia. This article is along this line of thought trying to explore the relevant factors which affect the efficiency of commercial banks on the basis of measuring. Section two is a brief review of the relevant literature, and section three is about my research methods, model and data description, the following part is the empirical results and their analysis, and the last section is the conclusion.

2. Literature Review

With the rapid expansion and development of the banking sector, as well as its important position in China's financial system, the efficiency of banking industry has become the focus of academic attention. Early banking efficiency study mainly includes the size and scope of the economic efficiency. Recent studies have concentrated on the X-efficiency and Total Factor Productivity. Berger and Humphrey [1] have contributed a lot to the research by summarizing five main efficiency evaluation methods, namely stochastic frontier approach (SFA), distribution free approach (DFA), thick frontier approach (TFA), data envelopment analysis (DEA), and free disposal hull (FDH). SFA and DEA are currently often adopted in China. The main advantage of DEA—this non-parametric method—lies in: 1) DEA does not need to construct a certain basic production function or the parameters coefficients of estimated function, which can avoid undesirable results that caused by humanly wrong function patterns settings; 2) DEA can effectively deal with the issues of qualitative and quantitative input (or output) indicators, which can settle the ratio scale and scale sequence data compatibility with less restriction of observed values. Bank efficiency includes technical efficiency, pure technical efficiency, scale efficiency. Technical efficiency is used to measure the ability of producers receive maximum output in the existing level of technology, scale efficiency reflect the impact of changes in the size of efficiency, pure technical efficiency is the remaining part of the post-impact technical efficiency in expenditure scale change.

Researches on efficiency in the banking sector in China domestic analysis which based on the application of DEA mainly contain: Zhao Xu [2] considered to use a variety of indicators and input-output model to study the efficiency of state-owned commercial banks; Zhao Xu and Kang Ling [3] used DEA to estimates China's commercial bank technical efficiency, pure technical efficiency and scale efficiency, and believed that the main factors affecting the efficiency of China's banking sector is the quality of bank assets, human capital, management capacity, ownership structure, and the degree of competition in the market; Zhang Jianhua [4] firstly used Malmquist efficiency index to analyze the changes in China's banking industry over the recent years; Chen Jingxue [5] explored the relationship between the overall performance and internal effect and the reallocation effect; Zhu Nan, Zhuo Xian *et al.* [6] used the DEA and Tobit regression model to analyze state-owned commercial bank efficiency, finding that the main reason of inefficiency was the ambiguous property rights and the low profitability of state-owned commercial banks; Zheng Lujun and Cao Tingqiu [7] also used DEA and found that there is no significant difference in efficiency between state-owned banks, nationwide Joint-stock Commercial Banks and city commercial banks; Tan Zhengxun [8] improved the traditional DEA method and reasonably define the bank input and output indicators, besides, he estimated of China's commercial banks efficiency index between 1997-2003 by using exponential Malmquist model; Yang Daqiang and Zhang Aiwu [9] showed that there existed dramatic cost efficiency and profit efficiency in China's commercial banks between 1996-2005; Tan Zhengxun and Wang Cong [10] used two-step DEA model and Principal Component Method to find that scale efficiency and allocative efficiency had a greater influence on the overall bank efficiency, and allocative efficiency and corporate governance had a greater impact on bank competition; Ke Konglin and Feng Zongxian [11] also studied the efficiency on the basis of efficiency measurement.

However, through all of the above literature, as an important indicator of bank performance, evaluation of non-performing loans have not been taken into account. In recent years, the impact of non-performing loans on the efficiency of banking industry has attracted wild attention of scholars. Zhang Jianhua and Chi Guotai considered the bank efficiency under non-performing loans condition; Ke Konglin and Feng Zongxian suggested that non-performing loans be considered as the "unexpected" output; But when there exists excessive input or insufficient output, or in other words, the input or output of non-zero slack exists, the radial DEA will overestimate the efficiency of the evaluation objects, and the angular DEA efficiency measurement will lead to the incorrect calculation results due to the ignorance of one of the input or output; Qin Taoai and Li Xingfa [12], Wang Bing,

Zhu Ning [13], etc. respectively studied the efficiency of rural credit cooperatives and joint-stock commercial bank using SBM-Undesirable model; Huang Huichun, Cao Qing and Li Gucheng [14] studied the reform effect of 50 rural credit cooperatives in Jiangsu Province, using the SBM-Undesirable model. Along with our national economy entered into a "new normal", especially since 2013, with the slowdown in economic growth, the resurgence of the banking non-performing loan ratio, the bank's operating efficiency should take what kind of change to deal with the "new normal" is a new question. Accordingly, this article will adopt two-stage analysis method on the basis of SBM model which added undesirable output, to measure the efficiency of 25 Chinese commercial banks in 2003 - 2014, and to conduct an empirical analysis on the key factors affecting the efficiency, thus evaluating the effectiveness of China's banking reform in recent 15 years and giving feasible advice on the future reform direction.

3. Research Methods, Models and Data Description

(A) SBM-Undesirable model

In those existed research, efficiency evaluation method can be divided into parametric and non-parametric methods, parameters comprises thick frontier approach (TFA), distribution free method (DFA) and stochastic frontier approach (SFA); non-parametric methods includes data envelopment analysis (DEA) and the Free Disposal Hull (FDH). Because the non-parametric method does not need to set function, thus avoiding the error caused by function setting (Berger, 1997).The applications are variable, among which is the DEA method. According to the definition by Charnes, Cooper and Rhodes (1978), if we put the constant scale rewarding model--DEA model (CCR model), which can be expressed as follows:

$$\text{Min}\left[\theta - \varepsilon\left(\hat{e}^{\text{T}}S^- + e^{\text{T}}S^+\right)\right]$$

$$\text{s.t.} \sum_{j=1}^{n} X_j\lambda_j + S^- = \theta X_0, \sum_{j=1}^{n} Y_j\lambda_j - S^+ = Y_0 \tag{1}$$

$$\lambda_j \geq 0, j = 1, 2, \cdots, n, S^- \geq 0, S^+ \geq 0$$

n is the number of decision-making units, X, Y are input matrix and output matrix, respectively, S^- and S^+ are input slack and output slack. Adding assumption $\sum_{j=1}^{n} \lambda_j = 1$ in this model, it will be changed into variable scale rewarding modell—DEA model (BCC model). In the model, when $\theta = 1$, the decision making unit is valid; when $0 < \theta < 1$, the decision-making unit is invalid.

Traditional DEA model is radial, which will cause the input and output elements be crowded or flabby in the process. Therefore, Tone (2001) took the inefficient factors - relaxation and relaxation input-output into account on the basis of DEA, and proposed measurement based on slack variables (SBM). Subsequently, Tone *et al.* (2006) added undesirable output into SBM model. This paper will base on this method, and construct SBM-Undesirable bank efficiency measurement model, whose basic form is as follows:

Suppose there are n banks making unit (DMU), each decision unit has three elements—inputs, expected outputs and undesirable outputs. Bank investment vector matrix is $X = [x_1, x_2, \cdots, x_n] \in R^{m \times n}$, expected output vector matrix is $Y^g = \left[y_1^g, y_2^g, \cdots, y_n^g\right] \in R^{S_1 \times n}$, undesirable output vector matrix is $Y^b = \left[y_1^b, y_2^b, \cdots, y_n^b\right] \in R^{S_2 \times n}$, and $X > 0, Y^g > 0, Y^g > 0$, the production possibility sets of constant scale reward (CSR) is:

$$P = \left\{\left(x, y^g, y^b\right) \middle| x \geq X\lambda, y^g \leq Y^g\lambda, y^b \geq Y^b\lambda, \lambda \geq 0\right\} \tag{2}$$

The SBM-Undesirable model is:

$$\rho = \min \frac{1 - \frac{1}{m}\sum_{i=1}^{m}\frac{s^-}{x_{i0}}}{1 + \frac{1}{s_1 + s_2}\left(\sum_{r=1}^{s_1}\frac{s_r^g}{y_{r0}} + \sum_{r=1}^{s_2}\frac{s_r^b}{y_{r0}^b}\right)}$$

$$\text{s.t. } x_0 = X\lambda + S^-, y_0^g = Y\lambda - S^+, y_0^b = Y\lambda + S^b \tag{3}$$

$$s^- \geq 0, s^+ \geq 0, s^b \geq 0, \lambda \geq 0$$

These, s_i^-, s_r^g, s_r^b, were the i-th commercial bank's input redundancy, insufficient amount desired output, and the negative output overrun. s^-, s^g, s^b are corresponding vector, λ is the weight vector. The objective function ρ is decreasing function of s_i^-, s_r^g, s_r^b. For a particular DMU, if and only if $\rho = 1$, which means $s^- = s^g = s^b = 0$, the bank is efficient; when $\rho < 1$, the bank exists a missing efficiency. There exists at least one element having improvement room between inputs, outputs and undesirable output.

ρ in Formula (3) is bank technical efficiency (TE), which also known as total efficiency. Adding different constraint conditions on $e\lambda$ (e for a unit vector), we can get the scale reward effect model (SBM-Undesirable). When $e\lambda = 1$, Formula (3) is variable reward scale (VRS) model, ρ is pure technical efficiency (PTE) of rural credit cooperative; when $e\lambda < 1$, Formula (3) is decreasing reward scale (DRS) model ; when $e\lambda > 1$, Formula (3) is increasing reward scale (IRS) model.

(B) Selection of Input and Output Indicators

There is no uniform standard in the selection of input and output indicators of commercial bank, but it is generally believed that there are four methods: production approach, inter-mediation approach, value—added approach, and user—cost approach, among which the most commonly used method is the production and inter-mediation approach. Production method views bank as producers of deposit and loan business. Investment is its business cost, and output is the amount of deposit account and the number of loan services; inter-mediation approach views bank as financing intermediary between depositors and borrowers, the investments are cash, interest, labor costs and fixed assets, the outputs are for all kinds of loans plus investments. Each method has its own advantages and disadvantages. This paper will give priority to the inter-mediation approach, the selected indicators combined with the advantages of the production method are as follows: input contains the net value of fixed assets, deposits, business spending; expect output includes pre-tax profits and non-interest income; the undesirable output is non-performing loans.

(C) Samples and Data Sources

This paper chose and analyzed the data from 25 commercial banks in 2003-2014, including Industrial and Commercial Bank, Agricultural Bank, Construction Bank, Bank of China, Industrial Bank, Shanghai Pudong Development Bank and other 15 national commercial banks, and Bank of Nanjing, Bank of Beijing and other 11 regional commercial banks. Data came from Bankscope database, GTA database, China Financial Yearbook, Annual Reports. The data in 2003 from Zheshang Bank, Bank of Ningbo, Bank of Luoyang, Fudian bank is missing. Statistical Descriptions of each variable are shown in **Table 1**.

4. Empirical Results and Its Analysis

(A) Technical Efficiency of Commercial Banks

I adopted SBM-Undesirable model, using DEA-SOLVER software, to measure the technical efficiency of 25 commercial banks in 2003-2014. In order to investigate the "bad" influence of output, I separately calculated the efficiency with or without the condition of non-performing loans, and respectively demonstrated the results based on three levels—the **state-owned commercial banks**, **joint-stock commercial banks**, and **city commercial banks**. As shown below in **Table 2**.

Table 1. Descriptive statistics of each variable.

Variable	Means	Std	Min	Max
net value of fixed assets	204.18	381.01	0.49	1721.97
deposit	17672.36	30258.96	76.31	150241
business spending	395.39	653.16	0.7	2992.8
pre-tax profits	316.20	622.95	0.30	3616.12
non-interest income	136.41	277.50	0.08	1653.7
non-performing loans	369.79	1160.56	0.15	8188.53

Table 2. Technical efficiency of 2003-2014commercial banks.

		All	State-owned	Joint-stock	City commercial
	2003	0.3081	0.2570	0.2221	0.4940
	2004	0.3259	0.2111	0.2470	0.4860
	2005	0.2905	0.2116	0.2223	0.4178
	2006	0.3869	0.2495	0.3131	0.5533
	2007	0.5100	0.5376	0.4098	0.6173
	2008	0.3740	0.3863	0.3095	0.4460
consider NPL	2009	0.4190	0.4905	0.3732	0.4352
	2010	0.5000	0.6000	0.5197	0.4203
	2011	0.5918	0.6937	0.6444	0.4707
	2012	0.6155	0.7255	0.6691	0.4889
	2013	0.6412	0.7880	0.7341	0.4459
	2014	0.7027	0.7737	0.7667	0.5851
		All	State-owned	Joint-stock	City commercial
	2003	0.2760	0.2396	0.1789	0.4682
	2004	0.2839	0.2313	0.2041	0.4107
	2005	0.2444	0.2227	0.1673	0.3507
	2006	0.2874	0.2353	0.2036	0.4189
	2007	0.4069	0.5696	0.3309	0.4094
	2008	0.3538	0.4573	0.2914	0.3728
consider NPL	2009	0.4134	0.6007	0.3487	0.3884
	2010	0.4545	0.6842	0.4403	0.3444
	2011	0.5474	0.7621	0.5934	0.3717
	2012	0.5957	0.7659	0.6605	0.4219
	2013	0.6348	0.8330	0.7719	0.3572
	2014	0.7215	0.8398	0.8039	0.5551

Charts 1-4 show while taking into account non-performing loans and non-performing loans without considering changes in the efficiency of banking technology trends:

We can see from the data that during the inspection period, the efficiency value under the consideration of undesirable output is higher than that of the condition without the consideration of undesired output, which is more obvious in joint-stock commercial banks, and city commercial banks. I think that the reason for this result is because non-performing loans are included into the output of non-performing loans, and around the year of 2002, NPL ratio of the banking sector is at the peak, when our country launched the reform of the banking sector. Besides, in 2003, the banking loan classification management is introduced, so the banks NPL ratio decreased significantly. So with the non-performing loans decreased, the bank had more actual output and higher technical efficiency. The reasons why banking NPL ratio decreased are not only because the government sporting (for example, the nation set up four asset management companies to help the big four state-owned banks strip non-performing loans), but also because the economic development (for example, land value increment caused land or plant mortgage loan be normal loans), and internal factors such as the improvement of operation and management capability of banking industry. These all resulted in the ignorance of undesirable output, which leaded to the underestimated efficiency.
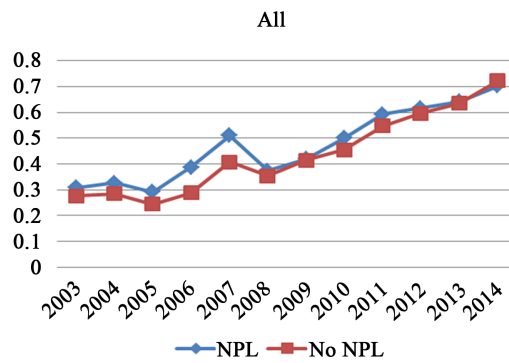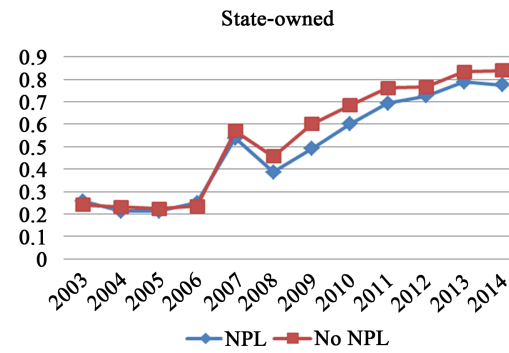
Chart 1. All banks' technical efficiency.

Chart 2. State-owned banks' technical efficiency.
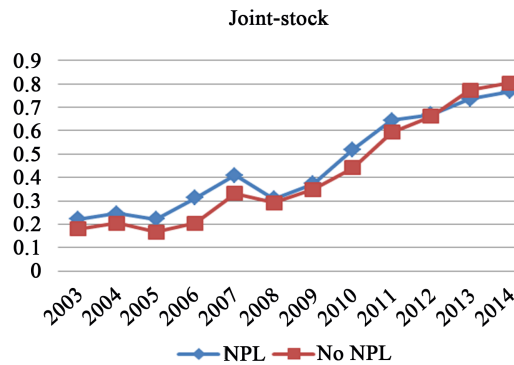

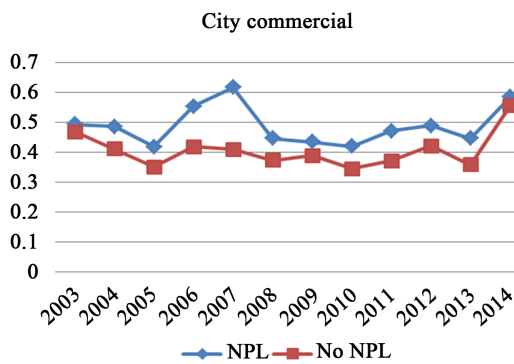**Chart 3.** Joint-stock banks' technical efficiency.

Chart 4. City commercial banks' technical efficiency.

In the case of undesirable output, the overall efficiency of the banking sector rose in 2003-2014. In 2003-2005, efficiency value of state-owned Banks and joint-stock Banks showed a trend of volatility. City commercial banks even dropped from 0.4940 to 0.4187, a decrease of 15.24%.I believe that the main reason is that there is an adjustment period in the traditional banking industry after the banking reform in 2002, for the introduction of new regulatory and assessment system. At the same time, the effect of the reform also has a lag period, so in 2005-2007, a significant improvement in the efficiency of the bank occurred. National banking rose to 0.5100 from the 0.2905, or 75.56 percent, thanks to the good foundation laid before. The decline in 2008 was due to the sudden struck of financial crisis. And thanks to the timely introduction of the "four trillion" policy from the beginning of 2009, the banking sector continue to enhance the efficiency value, as is 0.7027 of 2014.

(B) Banking Efficiency Decomposition

The multiplication of pure technical efficiency and scale efficiency is technical efficiency, and we can decompose the technical efficiency. Scale efficiency reflects the scale level of the banking sector, pure technical efficiency is the technical condition of technical efficiency of commercial banks after removing scale efficiency, which can be approximately understood as management efficiency. The data results are shown in **Table 3**.

The trend diagram is as follows.

As it shown in **Table 3** and **Chart 5**, pure technical efficiency in China's banking industry as a whole showed a trend of fluctuations rise, main in 2005-2007 and 2008-2007 these two stages, overall respectively rose 57.09% and 67.88%, which means that banking management level has significantly increased. Although pure technical
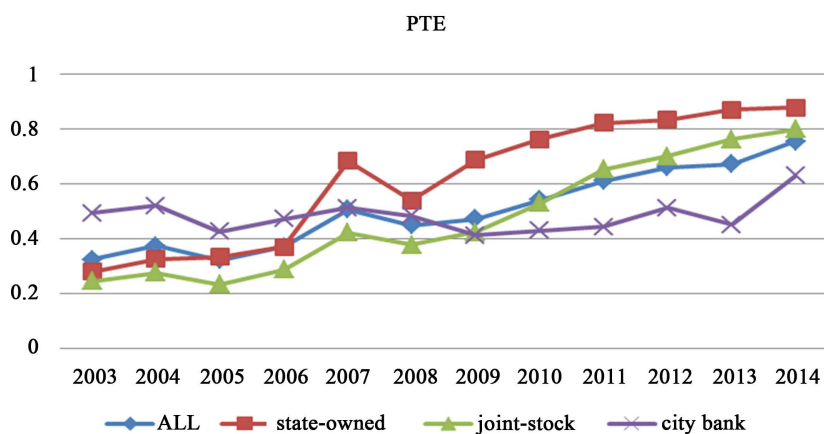

Chart 5. Pure technical efficiency.

Table 3. PTE and SE From 2003 To 2014.

	PTE				SE			
	All	State-owned	Joint-stock	City bank	All	State-owned	Joint-stock	City bank
2003	0.3249	0.2804	0.2457	0.4938	0.7560	0.6654	0.8850	0.6165
2004	0.3744	0.3268	0.2761	0.5210	0.8195	0.8779	0.8293	0.7752
2005	0.3232	0.3337	0.2343	0.4262	0.8834	0.9196	0.8466	0.9083
2006	0.3709	0.3706	0.2883	0.4721	0.8773	0.8785	0.8873	0.8644
2007	0.5077	0.6836	0.4230	0.5134	0.8220	0.7422	0.9399	0.7222
2008	0.4495	0.5399	0.3793	0.4849	0.9164	0.8651	0.9650	0.8856
2009	0.4733	0.6873	0.4251	0.4132	0.8990	0.8857	0.9729	0.8162
210	0.5414	0.7637	0.5311	0.4305	0.9546	0.9000	0.9765	0.9582
2011	0.6119	0.8229	0.6527	0.4447	0.9522	0.8615	0.9883	0.9586
2012	0.6603	0.8350	0.7013	0.5132	0.9463	0.8322	0.9641	0.9879
2013	0.6727	0.8716	0.7629	0.4520	0.9380	0.8428	0.9407	0.9876
2014	0.7546	0.8782	0.8001	0.6302	0.9032	0.7629	0.8979	0.9876

efficiency of state-owned banks and joint-stock banks in 2003-2006 was lower than that of the city bank, in 2009 the sequence was totally reversed, and the order is state-owned banks > stock banks > city banks. This shows that the reform of state-owned banks and joint-stock banks gained significant effect, while city commercial banks were restricted by the local government, slowing slow upgrade. On the other hand, by virtue of the advantages of scale and influence, talents attractiveness of big banks is much better than that of small banks, resulting in big difference in technical efficiency upgrading. So, small banks tend to attract talents from the big banks in reality.

As it shown in **Table 3** and **Chart 6**, although the scale efficiency also showed an overall upward trend, there was a big fluctuation, especially in 2003-2006. After 2009, state-owned banks fluctuate within 0.83 - 0.90, and joint-stock banks 0.763 - 0.988, only the city banks 0.988 - 0.817, and significantly decrease the size of the efficiency of the first two in 2014. Scale efficiency of the first two dropped significantly in 2014. This shows that in recent years, although big banks have a larger assets scale, the full use of the advantage hasn't been achieved, leaving still large room to improve in the future. Scale efficiency of city banks is higher, but the pure technical efficiency is lower than the former two. The internal management level improvement should be the focus in the future.

5. Analysis of the Factors Influencing Bank Efficiency

(A) Model Setting

This paper will construct panel data model, and empirically analyze the factors affecting the efficiency of commercial banks:

$$Y_{it} = u_{it} + \beta_{it} X_{it} + \varepsilon_{it} \tag{4}$$

Y_{it} is efficiency value of i-th bank in t-th year calculated by SBM-Undesirable, β_{it} is coefficients of selected independent variable, X_{it} is independent variables, ε_{it} is the random disturbance.

(B) The Selection and Analysis of Independent Variables

There are many factors that can influence efficiency of a bank's efficiency, not only internal organization management, the influence of the external factors are also important, such as the macroeconomic factors, government regulations, etc. Zhu Nan *et al.* surveyed influence of the return on net assets, equity ratio, state-owned and joint-stock banks and bank headquarters' location, etc. on the bank efficiency. Ding Jun [15] conducted a comparative analysis on the efficiency of local commercial banks and state-owned commercial banks from the aspects of operating performance, stability, and promotion on the economic growth. Zheng Lujun and Cao Tingqiu believed centralized ownership structure and corporate governance are important factors affecting the efficiency of Chinese commercial banks. It was also found that the size of the bank is a positive factor. Gan Xiaofeng [16] found that the economic cycle has a significant impact on the bank efficiency value, primarily through economic growth. State-owned property has a significantly negative influence. Tan Zhengxun (2005) and Ke Konglin and Feng Zongxian (2008) affirmed the role of the capital market to improve the efficiency of China's commercial banks. Wang Bing, Zhu Ning (2011) showed that the entry of foreign banks is conducive to
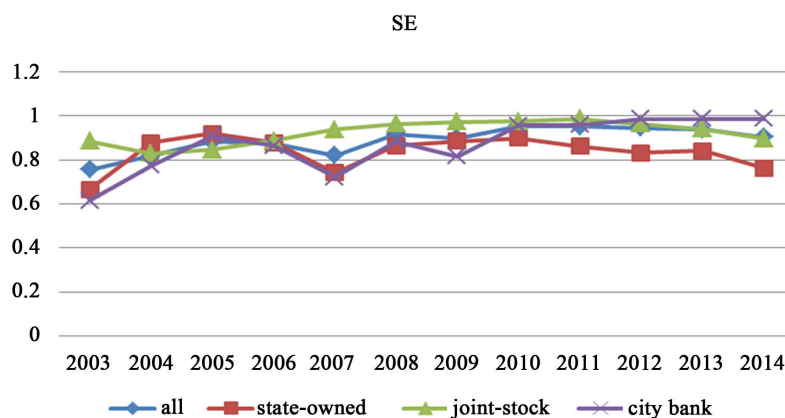

Chart 6. Scale efficiency.

the improvement of the performance of China's banks. With the existing researches and the characteristics of the commercial Banks in China, we can study the bank efficiency from the following 7 aspects: macroeconomic environment, regulatory measures, the degree of competition in the market, bank size, degree of innovation, profitability and corporate governance. Concrete analyses are as follows.

1. The macro environment: due to the imperfections of the capital market, the indirect financing has occupied a large proportion of the overall financing. This in turn results that the actual operating of the bank is closely related to the overall economic environment, Chinese scholars have done some relevant researches in this regard, such as Wang Cong, and Tan Zhengxun (2007). Based on this, I choose the fixed asset investment growth rate (FA) and the rate of monetary growth (M2) as the indicators reflecting the affecting factors of macroeconomic environment. Since there is a lag of about one year between the fixed asset investment's contribution to economic growth, the growth rate of investment in fixed assets is the data one year in advance.

2. Regulatory measures: commercial banks are institutions of risk management, which are critical to the stability of the entire financial system, so governments have strengthened supervision on the banking industrial all around the world. Due to the lag of market-oriented reform in 2003-2014 years, although the process of the banking marketization has continued to move forward, the most important marketization of interest rates of deposit and loans hasn't accelerated until this year. Therefore, this article takes lending rate (LR) to reflect the impact of the regulatory measures on banking sector.

3. The degree of market competition: along with our country banking industry market reform and the entry of foreign Banks, and even companies such as securities, trusts, funds through a series of innovative measures to circumvent regulation into traditional banking credit markets, these all have contributed to the banking competition pressure. I believe that the competition forced the bank to enhance the efficiency of the industry, resulting in a number of unique banks, such as the typical "small micro" business of Min Sheng Bank, "retail banking" of China Merchants Bank, and inter-bank business of Industrial Bank. In this paper I use the fender index (HHI) to measure the effect of market structure of bank efficiency, $HHI_t = \sum S_{it}^2$, and S_{it} is the market share for each commercial bank.

4. Bank scale: previous studies have indicated that bank scale is one of the important factors that affect the efficiency. In general, we can choose one of the total revenue, total assets, loans and deposits to reflect the size of the bank, and taking into account of the high correlation between the indexes, we choose the average total assets (ATS) as index to reflect the scale.

5. Degree of innovation: foreign experience shows that, after the marketization of interest rate, traditional margin income narrowed, so the vast majority of foreign banks have the financial innovation as an important channel to improve the performance and efficiency of bank. In western banks, off-balance sheet business income has accounted for 40% - 60% of its revenues, and off-balance-sheet business mostly belongs to innovation business. Recent years have seen a surge in the number of financial product circulation. Currently the stock of financial products exceeded ten trillion, becoming an important source of median income of the bank. In order to measure the degree of the innovation of the commercial Banks in China, we use the ratio of non-interest income (NII, after deducting the interest income gap) to total income, the greater the value of the index, the stronger the degree of the bank's innovation, the higher the efficiency of the bank.

6. Profitability: bank profitability is a measure of the current income level and the persistence and main indicators of growth in the future, not only reflecting the level of management, but also as an important basis for investors to do investment decisions. I assume that the profitability efficiency is related to the bank, so I use the total return on assets (ROA) to measure this indicator.

7. Corporate governance: based on the existing research, I assume that the corporate governance is related with the bank efficiency. Since the goal of corporate governance is to reduce the investment and get the output as much as possible on the basis of risk control, I select the LDR (LDR), cost income ratio (CIR) as the indicators of the efficiency.

See **Table 4** to find more detailed definitions of the variables.

(C) The Empirical Results and Analysis

This paper uses panel data model, using Stata 12.0 software to analyze the efficiency of 25 small and medium sized banks in 2003-2014 years. Data from Bankscope database, GTA database, China Financial Yearbook, Annual Bank, China Statistical Yearbook and the like. **Table 5** is a simple statistics of variables.

P value is 0.002 through Hausman test, so I use a fixed effects model to do a regression analysis on model 4, estimated results are shown in **Table 6**.

Table 4. Variable definitions.

Name	Variable	Definition
Fixed asset investment growth	FA	From the National Bureau of Statistics
Monetary growth	M2	From the National Bureau of Statistics
Lending rate	LR	Numerical end of each year
HHI index	HHI	Square sum of deposits' market share
Average total assets	ATS	Average of beginning and the end
The proportion of non-interest income	NII	Non-interest income/total income
Return on Total Assets	ROA	Total profit/average total assets
Loan-to-deposit Ratio	LDR	Loan/deposit
Cost to income ratio	CIR	Cost/income

Table 5. Statistics of variables.

	Mean	Std	Min	Max
FA	23.1831	4.8732	12.06	29.95
M2	17.1197	3.9762	11.01	27.58
LR	5.8953	0.6009	5.31	7.47
CIR	56.1739	29.9695	12292	240.353
ROA	6.6862	15.2271	0.2920	62.3437
NII	13.9731	13.1217	0.0347	74.0545
HHI	0.0754	0.0146	0.0531	0.1024
ATS	3.5317	0.8723	1.6448	5.2959
LDR	0.6911	0.0889	0.4443	1.1283

Table 6. Regression results.

Item	Coefficient	Standard error
FA	0.0020	0.0026
M2	−0.0057*	0.0029
LR	0.0329*	0.0189
CIR	−0.0033***	0.0007
ROA	0.1551***	0.0031
NII	0.0117***	0.0010
HHI	−11.3453***	1.9769
ATS	−0.2727***	0.07964
LDR	−0.2790*	0.1675
_cons	2.2627***	0.4838
R^2		0.5703
A–R^2		0.5162
OBS		296

Note: *, ** and *** represent the regression coefficient is significant at the 10%, 5% and 1% statistical level.

It can be seen that the fixed asset investment growth rate coefficient is positive, but the impact on the efficiency of banks did not pass the significance test. The impact of money growth rate and cost income on banks is negative and passed significant test. I think this is because the excessive currency deposits increased the cost of bank debt, but there were not enough suitable assets for banks to serve, thus pulling down the bank efficiency. This kind of situation is "credit crunch" psychology. Loan interest rate coefficient is positive and very significant, which is in line with expectations. However, in the context of the interest rate marketization,whether in the future the bank has enough bargaining power to keep interest spreads is worthy of attention. Return on total assets has a positive effect and is very significant, and is also in accordance with previous expectations. Non-interest income ratio has a positive effect, and passed the test. In the future, to create the median income through innovative products and services is the viable option for banks against interest rate marketization. Policy change of "commercial bank law" is on the agenda, and modifications is expected to allow commercial Banks to set up wholly owned subsidiaries, and encourage banks to spin out the asset management business in order to better meet the era of the "big asset management" (China Ever Bright Bank has been at the forefront).At the same time to further enhance the share of non-interest income will be conducive to the bank to "light asset" transformation, and further enhancement of the efficiency. HHI index effect is negative and significant. Since this article uses bank deposit market share to calculate the index, which I think further verified the previous views. So Banks should actively absorb high quality assets to dock with deposits, otherwise it will not conducive to efficiency improvement. Average total assets has a negative effect, I believe that on the one hand, it reflects the quality of loans the banking industry needs to further enhance, on the other hand, it also reflects the operation concept of "asset priority" needs to change. With the progress of Internet technology, the bank can decrease the cost of guest attraction through the network rather than bank outlets to improve efficiency. Furthermore Min Sheng bank changed the traditional outlets to "community bank" is a beneficial attempt in "asset light". That the LDR effect is positive and significant shows that strong capital allocation ability of bank has a positive influence for the efficiency.

6. Conclusions and Suggestions

In this paper, we use SBM-Undesirable templates and panel data regression model to analyze the efficiency of Chinese commercial banks and its influence, and the resulting conclusions are as follows.

1. Overall, our commercial banks improved efficiency during this period, and the high rate of non-performing loan problem has been solved. Pure technical efficiency and technical efficiency trends are basically the same, scale efficiency grew rapidly until 2008, becoming gentle after 2008. Improve the management level is the main reason for the bank to improve efficiency.

2. During this period, state-owned banks, joint-stock banks, city commercial efficiency have been significantly improved. Taken separately, the highest overall efficiency is state-owned banks, and then joint-stock banks, followed by the City firm, which is relatively low. I think the main reason is that the large banks not only can achieve scale efficiency, but also have more resource to enhance the market competitiveness, but the city commercial banks influenced by the local government can't make decisions in full accordance with market principles and then affect the efficiency.

3. As China's economy comes into a new phase and spreads narrowed, banks face much more different environment. We should continue to promote internal reform, improve management capability, enhance innovation capability, in order to enhance efficiency and better compete in the market.

Since 2003, banking reform has achieved remarkable results. It should be said that the reform is a success. It should be said that the reform is a success, which is not only benefited from the implementation of proper measures, but also due to the prosperity of the macroeconomic environment and the bank's management improved. But now, as China's reform has entered deep, economic structural has some problems, resulting in non-performing loan ratio which continues to deteriorate, the banks must continue to enhance the management capacity and innovation creativity so that they can further improve efficiency, while supporting the development of the national economy.

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