

An Empirical Study on the International Competitiveness of Chinese Commercial Banks¹

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ABSTRACT – According to the Chinese government's commitments while entering the WTO, now China has cancelled many restrictions for foreign banks including the restriction of foreign exchange business, the geographic restriction of RMB business and the restriction of the establishment form of foreign banks. Foreign banks are now permitted to offer services to all Chinese clients and to set up the same city services points to make cross-region business. It means that nowadays foreign commercial banks and Chinese commercial banks are standing at the same start line to compete with each other.

The innovation of this paper is mainly reflected in the following three aspects. First, we made a complete and systematic summary about the latest achievements on the competitiveness of commercial banks, including the foreign and domestic authoritative method of the evaluation of international competitiveness of commercial banks, in order to build a solid theoretical foundation for the empirical analysis. The second is the multilevel empirical method. In addition to the innovation on the selected indicators of the traditional factor analysis, we also made a cointegration analysis on the macro-level variables which further strengthened the content of the international competitiveness of commercial banks. Thirdly, the data used in the empirical analysis are the latest ones released by the official website of the commercial banks, statistical agencies, regulatory bodies and related database by 2010, in order to ensure the validity and the timeliness of the empirical results.

KEY WORDS: Chinese commercial banks, factor analysis, competitiveness

Literature review

Foreign scholars' study on national competitiveness, corporate competitiveness and commercial banks' competitiveness started as early as the 1970s. The international competitiveness theory can be traced back to some of the classical school theory. Adam Smith's (1776) absolute advantage theory said that a country export the goods which have an absolute advantage by international trade in exchange for their necessary goods which have

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a high production cost and international competitiveness is reflected through the international trade and the absolute cost advantage. Ricardo (1817) proposed the theory of comparative advantage. Heckscher Ohlin's (1919, 1933) factor endowment theory proposed that the differences in comparative advantage between countries is based on differences of resource conditions and differences of production inputs, and the international competitiveness comes from a country's resources which are relatively rich. Then some scholars tried to explain the sources of international competitiveness from other perspectives. For example, Schultz (1961) emphasis the role of human capital played in the international competitive advantage and Posner (1961) said that science and technology are the main source of international competitiveness. These theories are mainly used to explain the practices in international trade.

The achievements of research on corporate competitiveness are rich as well. Harvard University Professor Spence (1998) proposed that the corporate international competitiveness is a enterprise's ability to trade in the international market. Trade flows, R&D management, industrial policy, domestic economic policy, monopolistic competition all have a profound effect on the corporate competitiveness. Feurer and Chaharbaghi (1999) thought that the corporate international competitiveness is a relative concept which can be reflected by the products and services of enterprise, the ability of enterprises and the development potential of enterprise. They established the three-dimensional competitiveness model and the corresponding qualitative evaluation matrix which are constituted by customer value, shareholders, corporate human resources, technical potential and financial strength. M. Oral (2001) defined the corporate competitiveness from the dynamic perspective: he believed that the corporate competitiveness is any result of the internal decision-making process, and he emphasized the impact of competitive environment so his study combined enterprise's internal conditions and external environment to analyze the corporate competitiveness. He pointed out that the corporate competitiveness is a function of industry advantage, cost advantage and strategic advantage. Lall (1999) said that the most effective way to enhance the international competitiveness of enterprises in developed countries is technological innovation. The researches on international competitiveness of commercial banks are also very rich. Ernesto and Federico (2000) proved that competition can increase commercial banks' ability to defend against risks and crises for the banks can improve their viability and development potential more quickly and targeted. Rajdeep Sengupta (2007) said that the international competitiveness of foreign banks primarily comes from its selection of high-quality customers. Bang Nam Jeon (2010) made his study on Asia and Latin America banking market and it is proved that the entry of foreign banks into local market that is conducive to the improvement of the competitiveness of local banking industry for the resources will be more optimally allocated. Tomas JT Balino and Angel Ubide (2009) analyzed the post-crisis banking industry and they found that the major challenges facing the banking industry are the trade-off between risk and benefit and the expansion of business. Ernesto Sehgrodsky (2000) considered from the perspective of banking supervision that the raise of the regulatory requirements is not good for the differential operation of banks but the dynamic of competition will be increased. Biker JA (2000) proposed that through mergers and acquisitions, commercial banks can get easier to form the economy of scale therefore enhance their international competitiveness.



Empirical research on the international competitiveness of Chinese commercial banks

After years' development in the market economy, Chinese banking industry turns from a state-owned monopoly industry into a competitive industry which is composed of state-owned commercial banks, large stock-joined commercial banks, regional stock-joined commercial banks(city commercial banks) and foreign commercial banks. Although the four kinds of banks are different in scale, target client and main business, the competition of market shares among banks is becoming increasingly fierce. The four major state-owned banks are China's earliest commercial banks, including Industrial and Commercial Bank of China (ICBC), Agricultural Bank of China (ABC), Bank of China (BOC) and China Construction Bank (CCB). At the beginning of reform and opening, each bank had its own specialization of business: Industrial and Commercial Bank of China was responsible for the industrial and commercial credit and individual saving; Agricultural Bank of China specialized in rural finance; Bank of China was in charge of foreign exchange business and the management of country's exchange reserves; China Construction Bank's main business was long term credit for infrastructure construction. With the continuous deepening of financial reform, four major banks are gradually turning in to full-service banks. In addition, as China's first national joint-stock commercial bank, the growing Bank of Communication is integrated into the category of large state-owned commercial banks.

The selection of indicators used in the evaluation system

Based on the principles of comprehensiveness, operability and multilevel, the indicators we use to construct the evaluation system of international competitiveness are mostly the financial index that banks released. The framework that JIAO Pujin proposed in his book *Study on International Competitiveness of China's Banking Industry* has some reference value to the construction of our evaluation system. Considering the principles and the data's accessibility, we have chosen the following indicators to construct the evaluation system of commercial banks' international competitiveness. Our evaluation system excludes the impact of institutional factors on commercial banks' international competitiveness. In fact, in developing countries, impact of institutional factors is significant. However in order to comply with the quantitative principle and the operational principle, we temporarily put aside institutional factors.

Table 1. Index system of evaluation

1 st level index	2 nd level index	3 rd level index	Code	Unit
Actual competitiveness	Security index	Asset scale	X ₁	10 billion yuan
		Capital scale	X ₂	10 billion yuan
		Capital -asset ratio	X ₃	%
		Capital adequacy ratio	X ₄	%
		Non-performing loan ratio	X ₅	%



1 st level index	2 nd level index	3 rd level index	Code	Unit
		Loan-to-deposit ratio	X ₆	%
	Liquidity index	Excess reserves ratio	X ₇	%
		Liquidity ratio	X ₈	%
		Return on assets (ROA)	X ₉	%
	Profitability index	Return on equity (ROE)	X ₁₀	%
		Profits per capita	X ₁₁	10000 yuan
		Net profit growth rate	X ₁₂	%
	Efficiency index	Operating expense ratio	X ₁₃	%
		Cost-to-income ratio	X ₁₄	%
		Deposit growth rate	X ₁₅	%
		Loan growth rate	X ₁₆	%
Potential competitiveness	Human capital	Proportion of staff highly educated	X ₁₇	%
	Technological progress	Proportion of R&D expenditure	X ₁₈	%
	Financial innovation	Proportion of non-interest income	X ₁₉	%
	Globalization level	Number of oversea branches	X ₂₀	office

Principle of factor analysis

Model of factor analysis

Factor analysis is originally used to process the issues about the correlation of multi-dimensional random variables under the linear transformation. By calculating the eigenvalues or eigenvectors of the correlation coefficient matrix, variables are aggregated into factors which contain main original information and are mutually independent. The model is as below:

Suppose there are n samples, each sample has p observations denoted as X_1, X_2, \dots, X_p .

$$\begin{cases} X_1 = a_{11}F_1 + a_{12}F_2 + \dots + a_{1m}F_m + \varepsilon_1 \\ X_2 = a_{21}F_1 + a_{22}F_2 + \dots + a_{2m}F_m + \varepsilon_2 \\ \vdots \\ X_p = a_{p1}F_1 + a_{p2}F_2 + \dots + a_{pm}F_m + \varepsilon_p \end{cases}$$

In matrix it is like:

$$X = \begin{pmatrix} X_1 \\ X_2 \\ \vdots \\ X_p \end{pmatrix} = \begin{pmatrix} a_{11} & & a_{1m} \\ a_{21} & \dots & a_{2m} \\ \vdots & & \vdots \\ a_{p1} & & a_{pm} \end{pmatrix} \times \begin{pmatrix} F_1 \\ F_2 \\ \vdots \\ F_m \end{pmatrix} + \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_p \end{pmatrix}$$



In the model, all variables consist of two parts: one is the few factors shared by all the variables, namely F_1, F_2, \dots, F_m ($m < p$), called common factors, which can be seen as m mutually perpendicular axes in multi-dimensional space; another part is the specific factors ε_i that variables respectively have, called unique factors which represent the parts of original variables that can not be explained by common factors. a_{ij} is called the factor loading, it is load of the i -th variable in the j -th common factor, namely the weight, which reflects the relative importance of the i -th variable to the j -th factor. Matrix A is called factor loading matrix.

In addition, variables need to satisfy the following conditions: i) F_i and F_j are not independent, and their variance both equal 1; ii) F and ε not related; iii) ε_i and ε_j are not relevant and their variance are different too.

Operation steps of factor analysis

Common factor analysis steps are as follows:

(1) Standardize original data processing to eliminate dimension impact

The ultimate goal of factor analysis is to integrate a small number of representative factors from a number of original variables in, so the precondition of using this method is that original variables need to have strong correlations. However, different indicators are often different in their economic significance and their representing form. In order to make these indicators comparable, they must be standardized. Standardization, that is, the non-dimensional treatment of evaluation index. Through some mathematical transformation method, we transform indicators with different natures and dimensions into relative value or quantitative value, and their directions keep consistent. Currently, the most commonly used approach is Z-score law.

The transformation formula is:

$$X'_{ij} = X_{ij} - \bar{X}_j / S_j,$$

in which

$$\bar{X}_j = \sum_{i=1}^n X_{ij} / n,$$

$$S_j^2 = \sum_{i=1}^n (X_{ij} - \bar{X}_j)^2 / (n-1), (i=1,2,\dots,n, j=1,2,\dots,p)$$

After standardization, the variable X'_{ij} satisfies that $E(X'_{ij}) = 0$, $Var(X'_{ij}) = 1$.

(2) Calculate the correlation coefficient matrix R of sample

$$R = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1p} \\ r_{21} & r_{22} & \cdots & r_{2p} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & \cdots & r_{np} \end{pmatrix}$$

The correlation coefficient r_{ij} is calculated by: $r_{ij} = \frac{1}{n} \sum_{a=1}^n X_{ai} X_{aj}$



(3) Calculate the eigenvalues and eigenvectors of the correlation coefficient matrix R

Eigenvalue is the sum of squares of factor loadings in a certain common factor, also known as characteristic root. In the process of extraction of common factors, common factors with the largest eigenvalue will be first extracted, and common factors with the smallest eigenvalues are the last ones. The purpose of factor analysis is to simplify the factor dimensions, hoping to be able to make the largest amount of total variance explained by the smallest number of common factors. Therefore the less the extracted factors are the better, and the more information that the extracted factors can explain the better.

Suppose the eigenvalue and eigenvector of R are $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_p > 0$ and u_1, u_2, \dots, u_p . According to the requirement that the cumulative contribution of factors shall be more than 85%, take the first m eigenvalues and corresponding eigenvectors to build the factor loading matrix:

$$A = \begin{pmatrix} a_{11} & & a_{1m} \\ a_{21} & \dots & a_{2m} \\ \vdots & & \vdots \\ a_{p1} & & a_{pm} \end{pmatrix} = \begin{pmatrix} u_{11}\sqrt{\lambda_1} & & u_{1m}\sqrt{\lambda_m} \\ u_{21}\sqrt{\lambda_1} & \dots & u_{2m}\sqrt{\lambda_m} \\ \vdots & & \vdots \\ u_{p1}\sqrt{\lambda_1} & & u_{pm}\sqrt{\lambda_m} \end{pmatrix}$$

(4) Calculate the cumulative contribution of m factors

The ability of each common factor to explain the original data can be measured by the total variance it explains, that is the proportion of variance it explains to the total variance of all variables, often referred to as contribution of factor. According to the standard that $\partial(K) > 85\%$ we can determine the value of K.

$$\partial(K) = \left(\sum_{m=1}^k \lambda_m \right) / \left(\sum_{m=1}^p \lambda_m \right)$$

(5) Calculate the comprehensive score

The common factors expressed as the linear combination of the original variables is like:

$$F_{mi} = \sum_{j=1}^p u_m \cdot X_{ij}, \quad i=1,2,\dots,n \quad m=1,2,\dots,p.$$

Take the contribution of each common factor as weight, the weighted sum is the comprehensive evaluation score:

$$F_i = \sum_{m=1}^p \beta_m \cdot F_{mi}, \quad \text{in which } \beta_m = \lambda_m / \sum_{m=1}^p \lambda_m.$$

Data sources

Based on the comparability and availability of data, the research objects of empirical analysis we chose are four large state-owned banks (Industrial and Commercial Bank of China, Bank of China, Agricultural Bank of China and China Construction Bank), ten national joint-stock commercial banks (Bank of Communication, China Merchants Bank, CITIC Bank, Shanghai Pudong Development Bank, China Minsheng Bank, Fujian Industrial



Bank, China Everbright Bank, Huaxia Bank, Shenzhen Development Bank and Guangdong Development Bank) and three foreign banks with relatively larger market shares in the Chinese banking market (HSBC, Standard Chartered Bank and Bank of East Asia).

Because some of these banks above have not yet released their 2010 annual report, most of the indicators selected in this paper are based on banks' 2009 annual report. Values of specific indicators see Appendix 1..

In the index system, for operating expense ratio (X_{13}) and R & D expenditure (X_{18}) are not available, they are temporarily removed from the factor analysis. In addition, based on the general level of education is higher in foreign banks than in state-owned banks, as to foreign banks' utilization of human resources, we assign the highest value of the index value of Chinese commercial banks.

Empirical results

Extract the eigenvalue and the eigenvector

The data in the next table shows, the five largest eigenvalues are 40.187, 19.927, 12.721, 9.456 and 7.236 respectively. Their cumulative contribution rate is close to 90%, so that the first five factors sufficiently have contained nearly all the information and they are sufficient to reflect the international competitiveness of commercial banks.

Table 2. Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	7.234	40.187	40.187
2	3.587	19.927	60.114
3	2.290	12.721	72.835
4	1.702	9.456	82.291
5	1.303	7.236	89.528
6	0.927	5.153	94.680
7	0.411	2.281	96.961
8	0.296	1.642	98.603
9	0.146	0.812	99.414
10	0.074	0.414	99.828
11	0.031	0.172	100.000
12	0.000	0.000	100.000
13	0.000	0.000	100.000
14	0.000	0.000	100.000
15	0.000	0.000	100.000
16	0.000	0.000	100.000
17	0.000	0.000	100.000
18	0.000	0.000	100.000

**Obtain the factor loading matrix and name the common factors**

In order to clarify the specific meaning of each common factor, we used maximum variance orthogonal rotation method to rotate the factor loading matrix and the matrix after rotation is shown in Table 3.

Table 3. Rotated Component Matrix

	Component				
	1	2	3	4	5
X2	0.977	-0.157	-0.070	0.028	0.021
X11	0.949	-0.188	-0.138	0.105	-0.005
X20	0.921	-0.039	0.148	-0.129	-0.022
X1	0.921	-0.336	-0.090	0.026	0.028
X19	0.791	0.050	0.177	0.121	0.117
X4	0.719	-0.088	0.104	0.187	-0.527
X6	-0.641	0.640	0.324	0.056	-0.132
X3	0.466	0.815	0.031	-0.160	0.082
X7	0.442	-0.778	0.116	0.076	-0.322
X17	-0.406	0.754	0.284	-0.006	0.055
X5	0.199	-0.686	-0.173	-0.535	0.366
X16	0.188	0.220	0.909	0.115	-0.027
X12	-0.086	0.082	-0.804	0.505	0.056
X15	-0.420	0.193	0.717	0.282	0.322
X10	-0.039	-0.142	-0.138	0.847	-0.043
X9	0.616	0.158	0.206	0.718	-0.056
X14	-0.529	-0.019	-0.362	-0.555	0.241
X8	0.119	0.065	0.079	-0.087	0.959

From Table 3, 18 variables are compressed into five separate comprehensive factors through mathematical treatment. From factor F1 to F5, the amount of information contained in each factor is descending in order.

The coefficients of the first factor F1 on X₁, X₂, X₄, X₆, X₁₁, X₁₉, X₂₀ are 0.921, 0.977, 0.719, -0.641, 0.949, 0.791 and 0.921, greater than the index' weight on other factors, including seven indicators: total assets, total capital, capital adequacy ratio, loan-to-deposit ratio, profit per capita, non-interest income and the number of overseas branches. Total assets, total capital, capital adequacy ratio, overseas branches reflect banks' scale strength. And loan to deposit ratio, per capita profit, non-interest income can be seen as banks' ability to innovate. So factor F1 can be summarized as the banks scale strength and innovation capacity.

The coefficients of the second factor F2 on X₃, X₅, X₇, X₁₇ are 0.815, -0.686, -0.778 and 0.754, greater than the index' weight on other factors, including capital-asset ratio, non-performing loan ratio, excess reserve ratio and the proportion of staff highly educated. Capital-asset ratio, non-performing loan ratio and excess reserve ratio are closely related to security of commercial banks' assets, while the proportion of staff highly educated can also



be seen as security of banks' human capital. Generally employees with higher educational levels are less possible to cause the operational risks. Therefore, the factor F_2 is a measurement of banks' risk management capability.

The coefficient of the third factor F_3 on X_{12} , X_{15} , X_{16} are higher than on the three indicators' weights on other factors, so this factor contains the information of net profit growth rate, deposit growth rate and loan growth rate. These three indicators can measure commercial banks' ability in its main business. Thus the factor F_3 can be summed up as commercial banks' marketing capacity.

The fourth factor F_4 is mainly determined by X_9 , X_{10} , X_{14} three indicators: return on assets, return on equity and cost-income ratio, reflecting the banks efficiency in using the invested assets, which can be seen as banks profitability.

The information of the fifth factor F_5 comes from X_8 , the liquidity ratio. Therefore, the factor F_5 measured bank's assets liquidity.

Calculate banks' score on each factor

According to the score coefficient of each factor on indicators, in each factor combined with the standardized indicators' value, we can calculate banks' ranking position on various factors.

Calculate banks' comprehensive score

According to banks' scores in individual factor, take variance contribution rate of each factor (see Table 2) as weight, the formula of banks' international competitiveness comprehensive evaluation score is as follows:

$$\text{comprehensive score} = 40.187 \times \text{score on } F_1 + 19.927 \times \text{score on } F_2 + 12.721 \times \text{score on } F_3 + 9.456 \times \text{score on } F_4 + 7.236 \times \text{score on } F_5$$

The banks' comprehensive scores and ranking see Table 10.

Table 4. Banks' score on each factor

	F_1	F_2	F_3	F_4	F_5
ICBC	2.16162	-0.60621	-0.41259	0.81079	-0.80804
ABC	0.45313	-0.48859	-2.33405	-0.41703	0.0145
BOC	1.97887	0.82165	0.52487	-1.63455	0.71855
CCB	1.70885	-0.20116	-0.08205	1.15658	0.88894
BOCOM	0.04498	0.44298	-0.30695	0.31603	-1.40349
CMB	-0.11358	0.66874	0.5608	-0.03142	-0.42051
CITIC	-0.45848	1.15433	0.79548	-0.71757	1.49124
SPDB	-0.75724	0.64966	-0.30012	-0.04561	1.02911
CMSB	-0.18216	0.93827	0.71587	0.90252	-0.82409
FIB	-0.54211	1.68534	0.09486	-0.05637	-1.24795
CEB	-0.63033	0.53065	-0.39989	-0.80709	-0.66258
HXB	-1.06538	-0.87525	-1.20116	0.49552	-0.47629



	F ₁	F ₂	F ₃	F ₄	F ₅
GDB	-0.8757	-0.45849	-1.28072	0.28015	1.91349
SDB	-0.69823	0.31548	0.1737	1.3403	0.22656
HSBC	-0.33254	-1.3935	0.44346	-2.42974	-0.32569
SCB	-0.45506	-1.90151	1.02919	-0.17183	-1.02721
BEA	-0.23663	-1.2824	1.97932	1.00932	0.91348

Table 5. Banks' comprehensive score and ranking

	F ₁	F ₂	F ₃	F ₄	F ₅	Comprehensive score	ranking
ICBC	1	13	14	5	13	0.713601	3
ABC	4	12	17	13	8	-0.250564	12
BOC	2	4	6	16	6	0.923191	1
CCB	3	10	10	2	5	0.809907	2
BOCOM	5	8	12	7	17	0.097184	7
CMB	6	5	5	9	10	0.125554	6
CITIC	10	2	3	14	2	0.187029	5
SPDB	15	6	11	10	3	-0.142876	11
CMSB	7	3	4	4	14	0.230535	4
FIB	12	1	9	11	16	0.034407	9
CEB	13	7	13	15	12	-0.322704	13
HXB	17	14	15	6	11	-0.742971	17
GDB	16	11	16	8	1	-0.441245	14
SDB	14	9	8	1	7	-0.052507	10
HSBC	9	16	7	17	9	-0.608225	16
SCB	10	17	2	12	15	-0.521445	15
BEA	8	15	1	3	4	0.062697	8

Analysis on empirical results

a) Analysis on scale strength and innovation capacity

The scale of commercial bank could influence not only its operational costs but also its development spaces and development potential. Commercial bank always takes much account of assets and accumulation of capital. Because of this precondition bank could keep on sustainable development. For scale strength 4 major state-owned bank are the leaders. It is inseparable with history evolution and national policy. Although bank's management benefit doesn't have an absolute relationship with its scale strength, powerful assets size could provide good conditions for sustainable development undoubtedly.

Factor F₁ contains innovation capacity which is embodied by profit per capita, non-interest income and other indicators. It is remarkable that 3 foreign bank exceed many other



joint-stock commercial banks on this factor. A reasonable explanation is although foreign bank is smaller than state-owned banks in scale strength, the long-term experience of operation in developed marketing make foreign bank focusing on innovations in finance and operational efficiency. At present most banks in developed countries provide self-service by using video terminal internet and phone. Unmanned operations in HSBC exceed 60% of its total operations. Thus many high-end clients are interest in foreign banks.

b) Analysis on risk management ability

Risk management ability is an ability of avoiding various kinds of manage risk to ensure the safety of capital. The operational status of commercial banks is decided by the quality of credit to a great degree. Only if the debtor have ability and are willing to repay capital with interest on schedule and then benefits of depositor & creditor and bank shareholder could be guaranteed. Thus to prevent non-performing loans banks should provision some capital as value-cash and central bank deposit to fulfill demand of withdrawal. NPL ratio and excess reserve ratio embody risk management ability of commercial banks from two points of view. The better the capital-asset ratio is, the better the ability of replying liquidity shortage using owned capital is, that is the expression of elevation of risk management ability.

For risk management equity commercial banks are better than state-owned banks. It is related to institutional employment mode. Besides unknown rights and responsibility the lack of professional skill result in the big value of NPL ratio. In the end of 2001 NPL ratio of 4 major banks is 25.37%. Now it is not exceed 10%. But it is still worse than banks in western developed countries. In raw data NPL ratio in 3 foreign banks is lower than it in nationalized banks. It explains that foreign banks are focusing not only at business in Chinese market but also at the security and liquidity of assets. However excess reserve ratio in foreign capital banks is always lower it makes them scoring lower in this factor.

Factor F_5 is representative factors of liquidity ratios. It embody in risk management ability to a certain degree. Lack of short-term liquidity is an ordinary event to other enterprise but to commercial bank it is really a big operational risk. Lack of paroxysmal liquidity may result in difficulty in operation and even many small banks might be bankrupt. Thus liquidity ratio in banking is higher than it is in other industries. The ratio is 30% normally.

c) Analysis on marketing ability

The third factor in evaluate system contains net profits growth rate, deposit growth rate and loan growth rate. These 3 indexes embody in the development ability in main business of commercial bank. From the ranking we could find out clearly that marketing ability of foreign bank is greater. Foreign bank catch up with and surpass state-owned in deposits & loan transaction by their humanized and scientific service. It make us realize that to compete with foreign bank, the only way is expanding source of income and developing intermediary business. The proportion of intermediary business in developed country banks is exceeding 40% of the total operating income. Some are 65%. Thus marketing ability includes competition not only in traditional business but also in development and marketing in intermediary business.



d) Analysis on profitability

Profitability is a factor which could embody competitiveness mostly. The contribution rate to the overall evaluation is 9.5%. For any enterprise profit maximization is the fundamental goal in operation. From the ranking list we could find out that banks that are on top in scale strength may not be on top in profitability. Profitability is not only related to the current resource quantity but also to the integration and the use of resource. Organization chart, Human resources, business process and other factors are all important to the profitability of banks. Profitability of BEA exceeds most Chinese banks. But the other two foreign banks are not impressive in profitability. Compare with Chinese commercial banks, familiarity of foreign banks in China remains to be improved. Unlike Chinese banks which have branches throughout the country, foreign banks tend to have higher cost of expansion. Besides, foreign banks are still in their initial stage of business development in China, it will take some time to absorb their initial cost of inputs.

Conclusion for factor analysis

According to the size of variance contribution rate Table 2, the factors that influence the international competitiveness of Chinese commercial banks most are followed by the scale strength, innovation capability, risk management capacity, marketing capacity and profitability. From the ranking list, the factors are mutually independent and they impact banks' international competitiveness together. Different banks may have different emphasis on factors, and this unbalanced development trend also shows the development spaces and development potential of Chinese commercial banks are enormous.

Cointegration analysis on Chinese commercial banks' international competitiveness

Through the integration of micro-level financial data and related indicators in the previous chapter, we use factor analysis to derive the competitiveness ranking of Chinese main commercial banks and gap between them and three foreign banks. In order to further understand the overall strength of China's banking industry from a macro point of view, we need to refer to Porter's "diamond model" and the empirical results of factor analysis to do cointegration analysis. Cointegration analysis can determine the various factors that affect the international competitiveness of China's banking industry and provide a basis to enhance its overall competitiveness.

The selection of variables

Different from the preceding factor analysis, the selected variables of cointegration analysis are time series data (2001-2010) related to the overall development of China's banking industry. Therefore, cointegration analysis on the one hand provides an empirical basis understand the content of commercial banks' competitiveness from a macro perspective, on the other hand, the longitudinal empirical method and the previous horizontal method are complementary.

According to Porter's "diamond model" and the empirical results of factor analysis, considering data's representative and accessibility, cointegration analysis will be carried out



mainly from five aspects: the bank's asset scale, profitability, risk management, innovation and development capacity and macroeconomic situation.

For banks' asset scale, we chose each year's total assets of China's banking industry (excluding non-banking financial institutions and foreign banks), denoted as AS. Measurement of banks' profitability in China's banking sector is the profits per capita, denoted by PP. For risk management capabilities, we select non-performing loan ratio, denoted by NPL. Innovation and development capability is based on the fact that innovation can only be driven by employees, and the level of human capital determine the average innovative capability of enterprises, so we select the proportion of employees with bachelor degree or above, denoted HR. Macroeconomic conditions, is on one hand the measure of the level of financial development, and it also reflects the market demand conditions of the banking industry. Thus we chose the indicator GDP, denoted by PGDP.

Finally, as to the selection of the explanatory variable—commercial banks' international competitiveness, we use the number of Chinese banks in the *top 1000 world banks* released by the British magazine "Banker" Since the 1970s, denoted by BC.

Sample and data

This time span of cointegration analysis is from 2001 to 2010. The data of the international competitiveness of commercial banks come from the British "Banker" magazine's *Top 1000 World Banks* results. Total assets come from the total assets of banking institutions released in China Banking Regulatory Commission's annual report. Profit per capita is the banking sector's after-tax profits divided by the number of employees of banking institutions released in China Banking Regulatory Commission's annual report. Non-performing loan ratio refers to the World Bank Web site statistics. Education level of employee data comes from the China Financial Yearbook. GDP per capita are taken from China Statistical Yearbook over years. Regression and test of the model are completed by Eviews 6.0 software.

Table 6. The data of China's banking industry

Year	International competitiveness	Total assets	Profits per capita	NPL ratio	Employees highly educated	GDP per capita
2001	14	144146	10452	29.8	14.51	8622
2002	15	188717	17521	26	17.91	9398
2003	16	254511	41928	20.4	20.11	10542
2004	19	290179	42239	13.2	20.69	12336
2005	19	342414	105198	8.6	24.1	14185
2006	25	399150	129279	7.1	26.97	16500
2007	31	481449	160539	6.2	32.96	20169
2008	45	572094	212703	2.4	33.88	23708
2009	52	726239	237816	1.6	38.3	25575
2010	84	862099	306269	1.1	42.31	29748



Modeling

To avoid the problem of heteroscedasticity, variables above are taken logarithm processing and marked as $\ln BC$, $\ln AS$, $\ln PP$, $\ln NPL$, $\ln HR$, $\ln PGDP$ separately.

To avoid the problem of spurious regression resulted from non-stationary of time series when modeling, a test for quiet running property of time series should be taken firstly. In this document ADF test methods are used for unit root test. Every ADF statistics are exceed 5% level of significance. This explains that null hypothesis could not be refused (i.e. time series is not stationary). After root of unity test of first-order difference & second difference in time series, the ADF statistics of second difference are not exceed 5% level of significance. This means level variables including $\ln BC$, $\ln AS$, $\ln PP$, $\ln NPL$, $\ln HR$, $\ln PGDP$ are the second order single obeyed process $I(2)$.

Table 7. Quiet running property test result of variables

Variable	ADF statistic	5% critical value	Prob.	Conclusion
$\ln BC$	3.499878	-3.320969	0.9999	non stationary
$D(\ln BC, 2)$	-8.179769	-3.403313	0.0005	stationary
$\ln AS$	-1.317273	-3.259808	0.5717	non stationary
$D(\ln AS, 2)$	-3.783777	-3.403313	0.0018	stationary
$\ln PP$	2.211535	-3.320969	0.9991	non stationary
$D(\ln PP, 2)$	-4.250265	-3.519595	0.0003	stationary
$\ln NPL$	0.736219	-3.259808	0.9844	non stationary
$D(\ln NPL, 2)$	-3.348504	-2.021193	0.0006	stationary
$\ln HR$	-1.046156	-3.259808	0.6854	non stationary
$D(\ln HR, 2)$	-4.599999	-3.403313	0.0012	stationary
$\ln PGDP$	0.497042	-3.259808	0.9744	non stationary
$D(\ln PGDP, 2)$	-4.189294	-3.519595	0.0248	stationary

In accordance with the result above every variable is with order single whole, this means requirement of cointegration analysis is made. If some kind of linear combination between variables is stationary long-term stationary relationship between variables is existed (i.e. cointegration relationship). Here is common E-G step approach to test cointegration relationship between explanatory variables and explained variables.



Relationship between international competitiveness and banking assets scale

First take static regression test by traditional OLS methods. Regression results are below

$$\ln BC = -9.5178 + 0.9987 \ln AS$$

T test (-6.348) (8.547) F test 73.043

After adjusting $\bar{R} = 0.9013$ $\textcircled{\text{DW}} = 0.8698$

Second take unit root test residual in the regression model. The result is in Table 8.

Residual series is stationary. Thus there is cointegration relationship between commercial bank assets scale and international competitiveness (i.e. long-term positive equilibrium relationship)

Table 8.

Variable	ADF statistic	10% critical value	Prob.	Conclusion
Residual u_1	-1.821336	-1.60014	0.0676	stationary

Table 9. Granger causality test between $\ln BC$ and $\ln AS$

null hypothesis	object	F statistic	Prob.
$\ln AS$ is not granger causality of $\ln BC$	8	1.84748	0.2996
$\ln BC$ is not granger causality of $\ln AS$		5.38395	0.10171

Then take granger causality test between two variables. The lag is 2. The result shows that there is no obvious causality between $\ln BC$ and $\ln AS$.

Relationship between international competitiveness and profit per capita.

First take OLS regression test:

$$\ln BC = -1.8792 + 0.4573 \ln PP$$

T test (-1.829) (5.049) F test 25.491

After adjusting $\bar{R} = 0.7611$ $\textcircled{\text{DW}} = 0.7472$

Second take unit root test residual in the regression model. The result is in Table 10.

Residual series is stationary. Thus there is cointegration relationship between profitability and international competitiveness (i.e. long-term positive equilibrium relationship)



Table 10.

Variable	ADF statistic	10% critical value	Prob.	Conclusion
Residual u_1	-1.60014	-1.31285	0.162	stationary

Table 11. Granger causality test between $\ln BC$ and $\ln PP$

null hypothesis	object	F statistic	Prob.
$\ln PP$ is not granger causality of $\ln BC$	8	0.94451	0.00067
$\ln BC$ is not granger causality of $\ln PP$		0.50029	0.64938

Then take granger causality test between two variables. The lags is 2. The result shows that the suppose of $\ln PP$ is not granger causality of $\ln BC$ could be refused under 5% level of significance. That means the change of profit per capita is the granger causality of the change of international competitiveness.

Relationship between international competitiveness and NPL ratio.

First take OLS regression test:

$$\ln BC = 4.2861 - 0.5101 \ln NPL$$

T test (51.467) (-13.790) F test 190.177

After adjusting $\bar{R} = 0.9596$ @ $DW = 1.5449$

Second take unit root test residual in the regression model. The result is in Table 12.

Residual series is stationary under 10% level of significance. Thus there is cointegration relationship between risk management ability and international competitiveness (i.e. long-term positive equilibrium relationship)

Table 12.

Variable	ADF statistic	5% critical value	Prob.	Conclusion
Residual u_1	-2.264887	-1.988198	0.030	stationary

Table 13. Granger causality test between $\ln BC$ and $\ln NPL$

null hypothesis	object	F statistic	Prob.
$\ln NPL$ is not granger causality of $\ln BC$	8	3.0274	0.19071
$\ln BC$ is not granger causality of $\ln NPL$		0.99778	0.46538

Then take granger causality test between two variables. The lags is 2. The result shows that there is no obvious causality between $\ln BC$ and $\ln NPL$.



Relationship between international competitiveness and HR.

First take OLS regression test:

$$\ln BC = -1.9904 + 1.6244 \ln HR$$

T test (-3.066) (8.168) F test 66.716

After adjusting $\bar{R} = 0.8929$ @ DW = 1.1298

Second take unit root test residual in the regression model. The result is in Table 14.

Residual series is stationary. Thus there is cointegration relationship between education level of staff and international competitiveness (i.e. long-term positive equilibrium relationship)

Table 14.

Variable	ADF statistic	5% critical value	Prob.	Conclusion
Residual u_1	-2.078769	-1.988198	0.042	stationary

Table 15. Granger causality test between $\ln BC$ and $\ln HR$

null hypothesis	object	F statistic	Prob.
$\ln HR$ is not granger causality of $\ln BC$	8	7.96917	0.04305
$\ln BC$ is not granger causality of $\ln HR$		0.13972	0.87495

Then take granger causality test between two variables. The lags is 2. The result shows that the suppose of $\ln HR$ is not granger causality of $\ln BC$ could be refused under 5% level of significance. That means the change of education level is the granger causality of the change of international competitiveness.

Relationship between international competitiveness and GDP p.c..

First take OLS regression test:

$$\ln BC = -9.6066 + 1.3345 \ln PGDP$$

T test (-7.941) (10.667) F test 113.778

After adjusting $\bar{R} = 0.9343$ @ DW = 0.7286

Second take unit root test residual in the regression model. The result is in Table 16.

Residual series is stationary under 10% level of significance. Thus there is cointegration relationship between income level ability and international competitiveness (i.e. long-term positive equilibrium relationship).



Table 16.

Variable	ADF statistic	5% critical value	Prob.	Conclusion
Residual u_1	-1.988198	-1.000873	0.026	stationary

Table 17. Granger causality test between $\ln BC$ and $\ln GDP$

null hypothesis	object	F statistic	Prob.
$\ln GDP$ is not granger causality of $\ln BC$	8	1.04096	0.45357
$\ln BC$ is not granger causality of $\ln GDP$		1.11882	0.43349

Then take granger causality test between two variables. The lag is 2. The result shows that there is no obvious causality between $\ln BC$ and $\ln GDP$.

From research results above here is the conclusion: asset size& profitability& risk management& performance& innovations and Macro environment are always embodying on international competitiveness. Although only Profit per capita and HR level are the significant causality of international competitiveness, the result of cointegration analysis shows that improvement on other factors can also improve international competitiveness. Asset size& profitability& HR and Macro environment are positive influence on competitiveness (especially the HR, its value increase 1 percentage point, the international competitiveness level increase 1.62 percentage points). NPL ratio is the only variable which is negative influence on competitiveness. NPL ratio increased 1 percentage point, the international competitiveness level decrease 0.5 percentage points. Note that NPL ratio of nationalized bank improves a lot in recent years. The NPL ratio of 4 big nationalized bank change from 25% into 5% or lower. However the veracity of this value is not conclusive.

Empirical and final conclusion

The initial role of commercial banks is only playing as a platform for financing, but after several centuries of evolution and development, commercial banking has become a modernization service sector collecting various types of financial services. Because of its special nature of business, it is not only highly relevant with economic lives, but also affects a country's financial and economic development. Through qualitative and quantitative analysis above, the main conclusions of this paper are the following:

Through years of reform and development, the operating system of China's commercial bank has been continuously optimized, the management level has risen and the international competitiveness has also enjoyed tremendous improvement. China's commercial banks have already got the strength to catch up with some of the great international banks in terms of scale power. However, the advantage should not only lie in total size but in quality as well. In the core competitiveness, such as intermediate business level, the level of human resources, capital and other indicators of quality there still exists a certain gap with foreign banks.



According to factor analysis, there are five main micro indicators among all which can reflect the actual and potential competitiveness of commercial banks, scale, innovation and development ability, risk management ability, market expansion ability, profitability ability as well as asset mobility. Among these five indicators, scale, innovation and development ability contributes the most to overall strength. On the basis of scoring results in these five indicators, we draw the following conclusions: State-owned commercial banks have obvious advantages in scale strength; Innovation capacity of foreign banks is higher than nearly half of the joint-stock commercial banks; in terms of risk management capabilities, joint-stock banks such as the Industrial Bank, Minsheng Bank, CITIC Bank show outstanding performances; as to market expansion ability, the three foreign banks are ranked top, which is closely related to their excellent intermediate business indicator; considering profitability ability, foreign banks and joint-stock commercial banks are ranked better than state-owned commercial banks. But for overall ranking, commercial banks which got higher scores are mostly those with great scale strength, showing that domestic banking sector in China should change from total amount expansion growth mode to content growth-oriented expansion mode gradually, that is through input-output ratio and raising labor productivity, with less costs and taking more output and efficiency, domestic commercial banks should focus on the development of financial innovation, improve business performance and enhance the risk management.

By co-integration analysis on macroeconomic data of the sector, the conclusion is: From 2001 to 2010, the most critical factors contributing to enhance the overall international competitiveness are the asset strength, profitability, capital quality, human resources and macroeconomic situation. Although among these five factors, only the level of per capita profit and human resources have a significant causal relationship with international competitiveness of commercial banks, there exists a long-run equilibrium relationship between the five factors and the dependent variable. The international competitiveness of China's commercial banks is on the rise whether as a whole or in various indicators.

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APSTRAKT - *Prema obavezama koje je kineska Vlada preuzela tokom procesa pristupanja u Svetsku trgovinsku organizaciju, Kina je ukinula mnoga ograničenja za strane banke, uključujući ograničavanja deviznog poslovanja, geografska ograničenja RMB poslovanja i ograničenja osnivanja stranih banaka. Stranim bankama je sada dozvoljeno da ponude usluge svim kineskim klijentima i da otvore gradska predstavništva kako bi uspostavili međuregionalno poslovanje. To znači da danas strane komercijalne banke i kineske komercijalne banke imaju istu startnu poziciju da se takmiče jedni sa drugima.*

Originalnost ovog rada se uglavnom ogleda u sledeća tri aspekta. Prvo, napravili smo kompletan i sistematski pregled najnovijih dostignuća na polju konkurentnosti poslovnih banaka, uključujući strane i domaće merodavne metode procene međunarodne konkurentnosti komercijalnih banaka, u cilju kreiranja čvrste teorijske osnove za empirijsku analizu. Drugi aspekt predstavlja multilevel empirijski metod. Pored inovacija vezanih za odabrane indikatore tradicionalne faktorske analize, takođe smo uradili kointegracijsku analizu promenljivih na makro nivou koja dodatno pojačava sadržaj međunarodne konkurentnosti komercijalnih banaka. Treće, podaci koji su korišćeni u empirijskoj analizi su najnoviji podaci objavljeni na zvaničnim sajtovima komercijalnih banaka, statističke agencije, regulatornih tela i srodnih baza podataka do 2010. godine, kako bi se osigurala validnost i pravovremenost empirijskih rezultata.

KLJU:NE REČI: *kineske komercijalne banke, faktorke analize, konkurencija*

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Annex A

Table 18. Factor analysis of raw data

	General assets X1	Capitalization X2	Capital assets ratio X3	Capital adequacy ratio X4	NPL ratio X5	Loan-to-deposit ratios X6
ICBC	117851	6789	5.76	12.36	1.54	58.63
ABC	88826	3429	3.86	10.07	2.91	55.19
BC	87519	5750	6.57	11.14	1.52	70.3
CCB	96234	5590	5.81	11.7	1.5	60.24
BoCom	33091	1638	4.95	12	1.36	71.97
CMBC	20679	1214	5.87	10.45	0.82	73.74
CITIC	17750	1028	5.79	10.14	0.95	79.43
SPDB	16227	681	4.2	10.34	0.8	70.29
CMBC	14264	889	6.23	10.83	0.84	78.28
CIB	13321	596	4.47	10.75	0.54	76.8
CEB	11977	705	5.89	10.39	1.25	79
HXB	8455	440	5.2	10.2	1.5	74.01
CGD	6664	343	5.15	8.98	2.4	70.04
SDB	5878	319	5.43	8.88	0.68	79.07
HSBC	1621	123	7.59	15.7	0.8	55.42
SBC	1311	109	8.31	14.1	0.5	94.87
BEA	1210	112	9.26	15	0.35	100.92

Note: Units of general assets and capitalization are hundred million and others are percent.

Table 19. Factor analysis of raw data (continued 1)

	Cash reserve ratio X7	Liquidity ratio X8	ROA X9	ROC X10	Profit per capita X11	NIM X12
ICBC	20.48	30.7	1.10	19.05	1672	2.26
ABC	20.24	40.99	0.73	18.96	739	2.04
BC	16.25	45.3	1.09	16.44	1111	1.82
CCB	18.24	49.63	1.24	20.87	1387	2.41
BoCom	18.34	28.02	1.01	19.26	382	2.29
CMBC	13.44	34.47	1	21.17	224	2.23
CITIC	13.34	48.12	0.94	12.91	193	2.03
SPDB	15.63	48.71	0.81	19.41	173	2.07



	Cash reserve ratio X7	Liquidity ratio X8	ROA X9	ROC X10	Profit per capita X11	NIM X12
CMBC	17.69	34.56	0.98	20.19	172	2.59
CIB	19.11	32.07	1.13	24.54	172	2.06
CEB	17.15	35.38	0.64	19.43	105	1.92
HXB	15.66	28.68	0.48	12.44	48	2.12
CGD	15.19	54.28	0.56	16.21	50	2.23
SDB	11.87	38.59	0.86	24.58	62	2.47
HSBC	12.38	35.6	NA	NA	7	1.69
SBC	15.24	28.7	0.32	3.86	4	2.15
BEA	13.05	40.1	0.74	8.04	12	2.11

Note: Unit of profit per capita is ten thousand and others are percent.

Table 20. Factor analysis of raw data (continued 2)

	Cost income rate X14	Deposit growth rate X15	Loan growth rate X16	Undergraduate rate X17	Non-interest income rate X19	Numbers of embranchmen t overseas X20
ICBC	38.78	18.83	25.33	66	20.47	22
ABC	43.11	22.96	33.05	60	18.28	10
BC	37.15	29.23	50.38	70	27.21	58
CCB	39.04	25.49	27.04	65	20.62	9
BoCom	38.87	27.13	38.44	72	17.11	6
CMBC	44.86	28.59	35.62	82	21.54	3
CITIC	39.95	42.33	45.9	92	11.81	1
SPDB	44.13	36.74	33.16	80	7.96	0
CMBC	42.17	43.51	34.19	78	22.22	0
CIB	36.69	42.56	41.22	72	13.73	0
CEB	46.82	32.23	38.5	71	19.09	0
HXB	44.88	19.79	21.13	73	7.69	0
CGD	48	34.4	22	72	13.22	0
SDB	41.76	26.04	26.24	75	14.09	0
HSBC	84.72	18	20.37	95	26.52	0
SBC	85.14	13.04	13.85	95	23.16	0
BEA	56.01	25.37	3.66	95	22.13	0

Note: Unit of numbers of embranchment overseas is number and others are percent



Annex B

Figure B-1. Scree plot of factor analysis

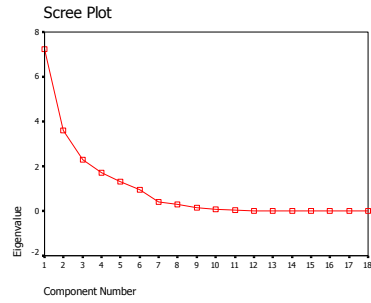


Figure B-2. Cointegration analysis of residual sequence

